Enviro Tex GmbH

Private Institute for
Product Safety and Environment

CAST CONSULTING

Final Report

Analysis of the Potential Impacts of Reach on European Textile Supply Chains

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Executive Summary

Introduction

The textile industry is an important industrial sector in the EU economy, which predominantly consists of SMEs and which currently faces a serious challenge due to the phasing out of import quotas, resulting in accelerating textile imports from China at all stages of textile production (fibres, yarns, intermediates, articles). It is a highly chemicals-intensive downstream user, and chemical substances provide an important source for its innovation capabilities and international competitive advantage**.** Therefore, the industry could be highly sensitive to potential substance withdrawal and substantial cost increases.

The European Commission service DG Enterprise & Industry, following a recommendation of the High-level Group on the Textiles and Clothing, has therefore agreed to undertake a study of the potential impacts on the textile industry of REACH (Registration, Evaluation and Authorisation of Chemicals), the proposed new European chemicals regulation. The approach and methodology of this study are similar to two REACH impact assessment studies carried out under the umbrella of the Memorandum of Understanding between the Commission and industry following a stakeholders' conference on the Commission's impact assessment of the new chemicals proposal in November 2003.

The Memorandum of Understanding (MoU) between the Commission and UNICE/CEFIC of 3 March 2004 defined the scope of the additional work as covering inter alia an investigation of the impact on the supply chain of substances of critical importance in the context of specific downstream industries and producers. To carry out the work under the Memorandum of Understanding, an Impact Assessment Working Group, containing representatives of industry, trade unions, and non-governmental organisations, has regularly met since April 2004 and discussed the progress of the two studies undertaken falling under the MoU, namely by KPMG for EU15 (inorganics, automotive industry, flexible packaging and electronics sectors) and by IPTS for the new Member States (specialty chemicals). The progress of this specific study on the textile sector has therefore also been presented and discussed in the above-mentioned Working Group.

The objective of the study has been to provide a business case study-based analysis of the likely impact of the proposed REACH chemicals legislation on actual supply chains within the textiles sector. This means that the study has collected factual evidence through in-depth interviews with chemicals suppliers and textile producers on how the introduction of REACH may affect textiles production. The analysis with the obtained business data, very often of a sensitive and confidential nature, has been targeted at identifying the mechanisms by which REACH affects the availability of chemicals of critical importance to a number of the textiles industry's supply chains, notably those of textile finishing. An important aspect of the study has been to identify those REACH mechanisms that potentially affect SMEs. The likely impacts on the profitability and competitiveness of the textiles companies involved in the case studies have also been evaluated, as well as any workability problems they see themselves confronted with.

Methodology

Although the methodology of the study has been similar to the studies falling under the remit of the MoU, it was necessary to make a few adaptations to reflect particular characteristics of the EU textile supply chains. The methodology document for the IPTS study has served as the basis of the work and as point of reference (IPTS / ESTO study "Guide to the assessment and interpretation of company interviews", 30 November 2004, discussed in the Working Group).

The set-up of the study has basically been three-fold: first, a desk research which serves as the basis and background of the next two parts of the study; secondly, business case studies focussing on a limited number of textile and chemicals companies (textile chemicals suppliers and textile finishers), linked together through real-life supply chains; thirdly, an economic analysis on the basis of the data and responses of the companies. Below, the consecutive steps of the study are discussed in more detail

(1) Desk research

The desk research has focussed on the use of chemicals in the European textile production, with the help of data provided by the industry associations Tegewa and Euratex, later on supplemented with data from the interviewed chemicals manufacturers. This survey has revealed the complexity of textile supply chains, which includes imports at all stages of production, the wide-spread use in textile production of a large gamma of chemicals, many of them of a specialized nature, and the pivotal role of textile finishing in the European textile sector.

Three remarkable facts have emerged from the survey. Firstly, the consolidated European textile supply chain uses about 1500 basic chemical substances and about the same number of speciality chemical substances, which combine to yield about 15000 preparations (textile auxiliaries and dyestuffs) marketed by chemical suppliers and used in textile production. For the textile chemicals, there is only a limited number of suppliers (around 50), nearly all of them based in Europe. Secondly, the interview data demonstrate that up to 90 % of the specialty chemical substances are produced in low volumes, i.e. below 100 tonne a year. Thirdly, most of the environmental impact of the textile finishing processes is coming from chemical substances contained in the input "grey textile", most of which is imported from outside the EU, and not from the used textile auxiliaries. For instance, for the environmentally very relevant pre-treatment step within textile finishing a mere 10% is attributable to textile auxiliaries, the other 90% or so to substances from "grey textile".

(2) The identification of substance groups and the selection of companies

The survey of the textile chemicals has served as the basis to identify six representative groups of substances of critical importance (to the process and/or the effect) for the European textile finishing industry. This selection has been discussed with national textile associations, members of Euratex as well as textile chemicals suppliers, members of Tegewa. Four of these groups have been used to map out actual supply chains and to select specific critical substances for a detailed analysis (for both points, see further below). The other two groups have been held in reserve.

The groups can be characterised by their critical component type or by the catch phrase of the "package" preparation in which the critical component is sold by the chemicals manufacturer. These are:

	"Package" type	Critical component type
1.	Softeners	Fatty acid condensation product
2.	Easy care products	Melamine resins, DMDHEU derivatives
3.	Dyeing carriers	Benzylbenzoate
4.	Cotton dyestuffs	Reactive dyes
5.	Synthetic fibres	Fatty acid esters

6. General formulation solvents Glycol(ether)s

The selection of the companies has taken place simultaneously with the selection of the substance groups. The selection has followed the criteria following from the terms of references and the methodology. The industry associations have assisted in finding candidate firms for the case study.

Finally, 13 companies have participated in the study:

- 4 textile chemicals suppliers,
  among which 1 SME;

  2 firms are located in Germany, 1 in a New Member State and one outside the EU
- 9 textile finishers,
  among which 7 SMEs and 2 also importers of Asian textile intermediates;

  they are located in the BeNeLux countries, France, Germany, Italy, Portugal, Spain and one New Member State.

The selection therefore demonstrates variety in location and company size (as required by the terms of reference). All firms have been checked beforehand whether they have a sufficiently wide product and process portfolio, and whether they have the capacity to participate on short notice.

(3) The track down of real-life supply chains and the selection of six critical substances

The next step has been the mapping out of real-life supply chains with the selected substance groups and companies as basis. Due to a number of specific features of the European textile sector, it was possible to identify the actual supply chains through a “short cut” as compared to the methodology of the two studies carried out under the MoU. As the number of textile chemical suppliers is limited as well as the critical components they produce themselves, it sufficed to ask the textile finishers for a list of the textile chemicals they use in their most important production processes or most critical “recipes” (self-made mixtures of textile chemical “packages” of different specialty chemical substances) and about which they can provide the required technical and business data. The consultants could then simply proceed to check with the selected textile chemical firms whether they produce the chemical in question and sell it to the indicated textile finisher.

In this way, it has been possible to fully trace 5 real-life supply chains, involving 6 specific critical substances out of the first 4 of the 6 pre-selected substance groups, tabled under point (2) above. After establishing the supply chain, the handed over technical and business data of the companies have been cross-checked with their business partner in the supply chain.

The selected six critical substances figuring in the five real-life supply chains are:

	Substance	Substance group	Tonnage band
1.	Fatty acid condensation product A	Softeners	10 - 100 t/y
2.	Fatty acid condensation product B	Softeners	10 - 100 t/y
3.	Melamine resin	Easy care products	100 -1000 t/y
4.	Benzylbenzoate	Dyeing carriers	100 -1000 t/y
5.	Reactive Dyestuff "Brown"	Cotton dyestuffs	10 - 100 t/y
6.	Reactive Dyestuff "Black"	Cotton dyestuffs	>1000 t/y

Due to reasons of confidentiality, the full (brand) names of the critical substances cannot be revealed.

Important factors in the choice of the six critical substances have been the spread over the already identified critical substance groups, the coverage of the various volume bands and the significance of the substances for their manufacturer and the textile finishers.

(4) The interviews with companies

Subsequently, the participating companies have been visited and interviewed. Beforehand, the questionnaires (derived from those used in the IPTS study) had been forwarded to them. An important part of questions concerned their current situation: their product portfolio and production process (with the opportunity for the consultants to double and cross check the data already handed over); their market position and economic outlook; their main competitive assets and innovation strategies; the communication within the supply chain and the nature of their business secrets; their competence and capacity to cope with the current environmental legislation.

The interviews continued with questions on the companies' knowledge of and preparedness for REACH; the technical workability of the REACH requirements (registration for the textile chemical suppliers and downstream user obligations for the textile finishers); their direct or indirect reactions to the costs related to the REACH registration, including consortium forming, cost absorption, cost pass-through, cooperation in the supply chain, portfolio rationalisations, decisions to whether or not continue specific production processes and/or market critical products; the impact of REACH on innovation; and the (business) benefits of REACH.

(5) The economic analysis

The economic analysis has been based on the interview results and the business data provided by the interviewed firms on the 6 individual critical substances, such as sales volumes and prices, gross profit margins and pay-back periods. These data are by nature very confidential.

Firstly, the vulnerability of the 6 substances to withdrawal for commercial reasons has been assessed through the so-called Net Present Value (NPV) analysis. This NPV method basically checks whether the discounted flow of gross profit margins can absorb the additional REACH registration costs. The method has been adopted from the IPTS study. The REACH costs are according to the cost scenarios of the ECB called "maximum testing needs" and "average testing needs", also used in the Commission's impact assessment of October 2003 and in the further impact assessment work carried out under the umbrella of the MoU.

Subsequently, the NPV calculations have been subjected to a sensitivity analysis in order to assess the robustness of the results. Key input parameters have been varied to see whether that would lead to different outcomes.

The inputs to the NPV calculations and the outcomes have been discussed with the firms. Specifically, the textile chemicals suppliers have been asked to indicate how they would react to the cost incidence and the indicated vulnerability of the substances; the textile finishers on how they could respond to the various possible actions of their suppliers. One of them was a calculated price increase in case of a full cost pass through. More detailed quantitative market analysis of cost pass through and market responses was not possible on account of flaws in the adopted IPTS methodology and lack of data. Instead, the firms have been queried on their current ability to absorb costs and raise prices.

(6) Reporting activities and feed back collection

The work in progress and the (preliminary) results have been reported on several occasions, firstly to the Working Group, the main task of which has been to guide the studies carried out under the MoU. A Draft Summary Report has been submitted to the Luxemburg Presidency Workshop on REACH on 10 May; the results have been discussed on the basis of a presentation. On a Validation Workshop on 31 May, the results have been presented to and discussed with representatives of textile and textile chemicals companies, with industry association representatives and other stakeholders. The remarks and additional information and suggestions coming from these audiences have been taken into account in the final report.

Impact of REACH on the textile chemical suppliers

1. A high proportion of critical low volume specialty chemical substances are vulnerable to withdrawal from the market. From the sample of 6 substances, only the high volume substance was found to be not vulnerable under all alternative assumptions scenarios. 3 substances were vulnerable under all scenarios and the other 2 were under some scenarios vulnerable. These last 5 critical substances include at least one environmental and consumer friendly substance (benzylbenzoate) that has replaced over the recent years substances with a more negative toxicological and ecotoxicological profile. It is important to recall that up to 90% of the 1500 textile specialty chemicals are produced in volumes below 100 tonne a year, and by a merely 50 suppliers, located in Europe.

The table below gives an overview of the results:

	Substance	Tonnage band	Indication of withdrawal risk
1.	Fatty acid condensation product A	10 - 100 t/y	Vulnerable
2.	Fatty acid condensation product B	10 - 100 t/y	Vulnerable
3.	Melamine resin	100 -1000 t/y	Vulnerable
4.	Benzylbenzoate	100 -1000 t/y	Vulnerable in some scenarios
5.	Reactive Dyestuff "Brown"	10 - 100 t/y	Vulnerable in some scenarios
6.	Reactive Dyestuff "Black"	>1000 t/y	Not-vulnerable

2. Vulnerability can often not be mitigated by recourse to consortia building and the use of alternative test methods because many specialty substances are complex due to varying technical grades and (eco)toxicological properties that render ineffectual the grouping of substances or the consideration of these different grades as same substances.

3. Textile chemical suppliers indicated that they wish to keep the functionality of the product portfolio intact. However, as they have indicated to dispose of limited possibilities to absorb REACH costs or to pass them on, some rationalisation of their portfolio will inevitably take place, in particular when entire packages need to be substituted due to the falling out of one or more critical components. The choice between substitution and de-selection will also depend on the expected future sales volumes of the substance concemed. Given the steady decline in European sales volumes of most textile chemicals, there is a particular incentive for manufacturers to accelerate the downsizing of their production through de-selection of clients and specific uses in order to arrive at a lower volume band.

4. Successful substitution of withdrawn substances and the subsequent reformulation efforts of packages of substances and preparations will take them between 1 to 9 months and cost 5 000 to 100 000 Euro per package.

5. These companies also pointed to a number of concerns on communication in the supply chain that will complicate registration of substances such as the current lack of information on imported formulations used in their production process; their rather low expectations on the quantity and quality of the information from their clients on their

identified uses; the chemical interactions in the textile finishing process of their products with other chemicals, already contained in the input grey fabric or from other finishing "packages", which is a problem they feel they cannot assume responsibility for, as it is out of their scope of observation.

Moreover, given the large number of clients and applications which the exposure scenarios of the textile chemicals company are supposed to cover, they perceive a great need for workable exposure categories and practicable IT tools.

6. In the interviews, the companies pointed to the business benefits of REACH which are related to their increase in about the real application conditions of the downstream users. This could have a positive impact on product liability and quality issues which often have to do with incomplete or asymmetric information on downstream user process details.

Furthermore, more knowledge on the specific uses of textile chemicals within textile finishing could trigger new product development on the chemical suppliers' level. However, this benefit may be in conflict with the direct commercial interest of specific textile finishers who need to keep their special application confidential.

Impact of REACH on textile finishers

1. Most textile finishers are SMEs. They are concerned about the availability of critical substances and preparations because their competitiveness depends on innovative uses of many of these specialty chemicals. They have limited financial and human resource capacity to cope with the costs, administrative requirements and required adaptations induced by REACH, either directly or indirectly through the responses of their textile chemical suppliers.

2. As some degree of withdrawal of these critical substances and preparations will inevitably occur, textile finishers will face significant reformulation and process adaptation costs, which they cannot absorb nor pass on their customers because of fierce competition in all textile markets. The indications of the interviewed companies are in line with the sectoral

data. Since the year 2000, both the volumes and prices of most textile chemicals and textile products have been decreasing.

3. Reformulation and adaptation efforts will take textile finishers between 3 to 18 months depending on whether they are able or not to keep the functionality intact of the “recipe” they use in their production processes. These time-to-market problems will clash with fashion cycles of consumer textiles and product cycles of the customers of industrial textiles. It should be noted that time-to-market is an important competitive asset for the European textile finishers. The costs per reformulation can run up to 300 000 Euro.

Moreover, the textile finisher fear that the REACH induced rate of required adaptations may pose insurmountable problems. Firstly, they are concerned that there will be a culmination of these efforts and adaptations as the textile chemicals withdrawals are likely to be concentrated at REACH registration deadlines. Secondly, they foresee a permanent strain coming from the REACH-induced changes at earlier stages of textile production which likely will have different lead times.

4. The textile finishers face workability problems with the downstream obligations of REACH, as all the alternatives available to them are potentially costly and/or may affect their competitiveness.

The identification of use to their suppliers will involve substantial costs and human resources, as they make use of a large number of textile chemicals in an even large number of applications. An additional complication is the incidence of a large number of unintended impurities and by-products which are not necessarily known to the textile finisher. However, due to earlier cost rationalisations in textile finishing and the relatively small company size, the textile finishers only have a limited capacity and experience to carry out the required tasks.

A close cooperation with the chemical suppliers to perform these tasks has two serious drawbacks. Firstly, the textile finishers are not guaranteed that the exposure scenarios of their suppliers will cover their idiosyncratic and often innovative use of their textile chemicals. Secondly, the identification of use carries the considerable risk for the textile finishers that they are left with no choice than to convey sensitive information on the use of chemicals to their suppliers. This could seriously affect their market position.

However, textile finishers don't see the notification of use to the Agency as an attractive alternative either to keep their specific use confidential. The reasons are basically the same as before: their own limited capacity and experience, and the shortage of suitable and reliable external experts with the corresponding costs.

5. Firms expect to incur a competitive disadvantage vis-à-vis non-EU competitors through the arrangements in REACH for substances in articles. As this arrangement starts to apply after the registration obligations for textile chemicals made and used in the EU, and has serious workability issues, some of which are specific for textiles, they fear that a level playing field will not be achieved without achieving the intended level of environmental protection. In the first place, article 6 starts to apply after 11 years and 3 months after the start of REACH. That is later than the required registration date of the EU textile chemical substances. Moreover, the threshold of 1 tonne per year is crossed more easily for a EU textile chemical substance than for the corresponding substance contained in an imported article or article type. This problem is aggravated by definition, information and monitoring problems for chemicals contained in imported goods.

6. In the interviews, the textile finishers pointed to the business benefits of REACH which are related to their increase in knowledge about the actual composition of the textile auxiliaries and dyestuffs. This could have a positive impact on product liability and quality issues which often have to do with incomplete or asymmetric information on the chemicals inputs. Furthermore, more knowledge on the composition of specific textile chemicals could make them better comparable and the market for textile chemicals more transparent. This would make the simplification of and the substitution in recipes easier, as well as the negotiations on price and service condition with their suppliers. However, this may conflict with the direct commercial interests of specific textile chemicals suppliers.

1 Introduction

The textile and clothing industries are an important industrial sector in the EU economy with a turnover of over 200 billion Euro and a labour force of over 2 million people [1]. The textile industry roughly accounts for half of that sector (a turnover of over 110 billion Euro and employment of more than 1 million people) The industry is predominantly composed of SMEs and currently faces a serious challenge due to the elimination of import quotas. This has led to an increase in textile imports, particularly from China, concerning all stages of textile production (fibres, yarns, intermediates, articles). It is a highly chemicals-intensive downstream user, and chemical substances provide an important source for its innovation capabilities and international competitive advantage. This holds especially true for the critical stage of textile finishing. As such, the textile industry could be highly sensitive to potential substance withdrawal. Therefore, some initial work on the impacts of REACH on the textiles industry has already been undertaken in the course of the elaboration of the Commission's own Extended Impact Assessment [2].

The European Commission service DG Enterprise and Industry, following a recommendation of the High Level Group on the Competitiveness of the Textile and Clothing Industry, has therefore agreed to undertake a study of the potential impacts of REACH (Registration, Evaluation and Authorization of Chemicals) [3] on the European textile supply chains. This study is similar in its approach and methodology to the studies carried out in the framework of the March 2004 Memorandum of Understanding [4] between the Commission and the industry associations UNICE and CEFIC, namely the KPMG study [5] for the EU15 (business cases on the supply chains within the inorganics industries, the automotive industry, flexible packaging and electronics sectors) and the IPTS study [6] for the new Member States (survey chemicals sector and business case study on speciality chemicals supply chains). Due to the similarities to the MoU studies, the progress of this REACH impact study on the textile sector has been presented and discussed in the Working Group containing representatives of the Commission, industry, trade unions, and non-governmental organisations, which monitored the progress in the MoU studies.

The *objective of this study* has been to provide a business case study-based analysis of the likely impact of the proposed REACH chemicals legislation on actual supply-chains of the textiles sector. This means that the study has collected factual evidence through in-depth interviews with chemicals suppliers and textile producers on how the introduction of REACH may affect textiles production. The analysis of the obtained business data, very often of a sensitive and confidential nature, is targeted at identifying the mechanisms by which REACH potentially affects the availability of chemicals of critical importance to a number of the textiles industry's supply chains, notably those of textile finishing. An important aspect of the study is to identify those REACH mechanisms that potentially affect SMEs. The likely impacts on the profitability and competitiveness of the textiles companies involved in the case studies has also been evaluated, as well as any workability problems they see themselves confronted with.

The methodology document for the IPTS study [7] which had been submitted to and discussed in the MoU Working Group, has served in this study as the basis of the work and as point of reference. However, it has been necessary to make a few adaptations to this methodology in order to better account for particular characteristics of the EU textile supply chains. These differences are further explained in this report.

The *set-up of the study* is basically three-fold:

1. A *desk research* on the role of chemicals in the European textile production, on the basis of data from previous studies and of data and responses from the industry associations; the resulting survey serves as the basis and background of the next two parts of the study;
2. *Business case studies* focussing on a limited number of textile and chemicals companies (textile chemicals suppliers and textile finishers), linked together through *real-life supply chains*;
3. An *economic analysis* on the basis of the data and responses of the companies interviewed in the various business case studies.

Guidance to the reader

This report builds on the basis set-up of survey, business case studies and economic analysis, explained above. The chapter structure is more elaborate in order to better reflect the various consecutive steps in the execution of the exercise, but also to give structure to the results coming out of the different stages of the study. Here, a short overview of the chapters is given to explain more fully the main structure of the report and to help the reader to find his way in the material.

Chapter 2 describes the main consecutive steps of the study's execution which directly follow from the methodology. The focus lies on the approach of the study, not on the results. Consequently, this chapter can be regarded as an overview of the first half of the report.

Chapter 3 provides a description of the European textile production with an emphasis on its supply chain structure and on the use of textile chemicals therein. This chapter starts with a broad, general sketch of the textile supply chain in section 3.1 and continues in the next two sections 3.2 and 3.3 by highlighting specific aspects of the textile chemicals industry and the textile finishing industry respectively. Section 3.4 summarizes the results.

The chapter reports the desk research part of the study, which is based on the interviews with industry associations, available literature and statistics, the professional experience of the consultants with both industries as reflected in reports over a period of two decades (see Annex 1) and supplemented with data coming from the case study interviews with representative companies of both industries.

Chapter 3.2 discusses in its 3 sections the aspects related to the textile chemicals industry part of the supply chain. Section 3.2.1 deals with basic facts, such as the definition of the term "textile chemicals" and the linkage between chemical substances of technical grade and textile chemicals formulations used in Textile Finishing Industry. Section 3.2.2 describes the major types of textile chemicals formulations in their sales form, the "packages". Section

3.2.3 provides a qualitative overview on chemical substances and their associated formulations used in the European Textile Chemicals and Finishing Industry.

Chapter 3.3 deals in 5 sections with the issues related to the textile finishing industry part of the supply chain. Section 3.3.1 explains the different types of textile finishers. Section 3.3.2 provides a quantitative overview on the most important textile chemicals group, namely the textile auxiliaries. Section 3.3.3 illustrates the typical recipe and process structure of textile finishing firms. Section 3.3.4 gives a broad sketch of the environmental fate of textile chemicals along the finishing process. Finally, section 3.3.5 points to the potential role of textile finishers as formulators.

Chapter 4 and 5 report on the selection and identification stages of the business case studies.

Chapter 4 describes how the groups of substances of critical importance for textile processes and effects have been identified. Section 4.1 gives the methodological background of the selection process; one important deviation from the IPTS methodology is explained there. Section 4.2 presents the resulting groups of critical substances. The selection has been based on the desk research and on the interviews with the relevant industry associations on European and national level. The selected substance groups are the starting point of the detailed business case studies covered in the following chapters.

Chapter 5 explains how the actual critical substances and related supply chains of the business cases have been identified. Section 5.1 concerns the selection of textile chemicals and textile finisher firms and the linkage between companies of both types with concrete critical substances coming out of the pre-defined substance groups. Section 5.2 presents the found real-life supply chains.

Chapters 6, 7 and 8 concern the analysis of the data coming out of the business cases

Chapter 6 reports on the economic analysis of the critical substances and the related supply chains identified in the previous chapter. The first two sections respectively give a short introduction to this long chapter and a description of the methodology of the quantitative parts of the analysis. The next five sections present the results of the quantitative NPV analysis which indicate whether a substance is vulnerable to be withdrawn from the market for commercial reasons and what the price increase would be in case of a full pass-on of the REACH registration costs. The last two sections present an assessment of the possibilities of passing on the costs and the potential effects on substance substitution.

Chapter 7 analyzes in more detail the potential for substitution and withdrawal and possible consequences for the case of substitution and withdrawal. The subjects of the three sections are respectively the dilemmas in the choice between registration of a vulnerable critical substance and finding a substitute for it, in general and for the 6 critical substances of this study specifically; the cost implications of reformulation and re-engineering after potential substitution and withdrawal; an example for potential negative environment, health and safety effects after the substitution or withdrawal of one of the critical substances.

Chapter 8 contains the outcomes of the business case interviews which have not been presented in earlier chapters. The subjects of the sections are time to market considerations; innovation and competitiveness; communication and confidentiality issues; environment, health and safety capacity and competence; and finally potential business benefits.

Chapter 9 considers the “substances in articles” issue discussing in detail four problem cases regarding imports to the textile supply chain.

Chapter 10 highlights some specific challenges for SMEs and recommendations how to handle these, based on the material and results of the previous chapters.

The main conclusions of the study can be found in the final *chapter 11*.

2 Main consecutive steps of the study

This chapter gives an overview of the main consecutive steps of the execution of the study. The steps 1 to 4 below have also been reported in the Interim Report of 24 February of this year; the Draft Summary Report of 21 April, which has been submitted to and discussed in the Luxemburg Presidency Workshop of 10 May, already contains a preliminary discussion of the remaining steps.

1. **Elaboration of an economic and technical methodology for the business case study.** This concerns the set-up of the questionnaires and of the selection process of substances and companies, and the choice of the tools of analysis. For this, we largely followed the methodology of the REACH impact assessment studies of KPMG and IPTS mentioned above in Chapter 1. Some points of the methodology have been adapted in order to better reflect particular characteristics of the EU textile supply chains. The chapters 4.1, 5.1 and 6.2 report on the methodology used in this study.

2. **A survey of the chemical substances and preparations used in textile industry,** including a broad sketch of the textile chemicals and textile finishing industries, and the chemicals they respectively supply and use. The sub-sector textile finishing has been selected as the survey confirmed that it uses the broadest range and largest number of textile chemicals. Chapter 3 contains most of this survey material, which is mainly based on the desk research and interviews with industry associations, but it also has profited from the results of the business case interviews with companies.

3. **The identification of six representative groups of substances of critical importance (to process and/or effect) for the European textile production,** which mostly figure as key ingredients of preparations sold by the textile chemicals suppliers. Chapter 4

describes this step in detail. This pre-selection based on the results of step 2 has been discussed with the textiles associations, members of Euratex, and the textile chemicals suppliers association Tegewa. It is from these groups that later on 6 single critical substances have been selected and used for the detailed economic analysis. The six substances have come out of 4 groups; two groups are represented with each two critical substances and two other groups with each one critical substance; the two remaining groups have been held in reserve**.**

4. **A first round of interviews with selected textile chemicals and textile industry firms has been held so as to identify six critical substances and their corresponding real-life supply chains out of the selected critical substances groups together with their textile applications.** The participating companies have been selected on technical and economical criteria and the demands imposed by the methodology of the study. Chapter 5.1 describes this process in detail. All these interview partners (4 textile chemical manufacturers and 9 textile finisher firms including 2 importers of textile articles) show a wide product and process portfolio, so that the probability to match manufacturers and users of critical substances has been high. 3 other foreseen companies declined further participation; the stated reasons varied from confidentiality concerns to organizational and economic problems. The matching has led to the identification of 5 real-life supply chains for 6 specific critical substances within 4 substances groups out of the 6 previously identified. Chapter 5.2 further explains this important step.

5. **Second round of interviews with the participating firms.** Firstly, these interviews have served to obtain sensitive, and quite often also confidential, business data on the economic situation of the company and its product portfolio and on individual chemicals. The interviews with different firms have led to cross-checks on these data also. Secondly, the interviews have served to query the companies on their reactions to the REACH registration requirements and corresponding costs. The analysis of their responses will be

presented in detail in chapter 8. The results of the analysis of the handed-over business data play of course an important role (see also the next point).

6. **The economic analysis of the data and the responses of the companies.** For the six selected critical substances, so-called Net Present Value (NPV) calculations have been conducted (see sections 6.3 to 6.7). The NPV indicates whether the registration costs of a specific chemical outweigh the future stream of (gross) profit margins and thus render the chemical in question vulnerable for commercial substance withdrawal. The NPV can also be used to calculate the price increase when the registration costs are fully passed on along the supply chain. The outcomes of the quantitative analysis have been discussed with the participating firms. The results have been used as the starting point for further qualitative analyses: on the possibilities of firms to absorb the costs or to pass them on down the supply chain, their prospects to withdraw vulnerable substances and to find substitutes, the corresponding efforts of reformulation or reengineering and other supply chain issues such as communication and cooperation within the supply chain, innovation and competitiveness aspects

7. **Substances in articles.** Two of the participating textile finishing interview partners could be identified as importers of textile intermediate importers (yarns and fabrics) from Asia. A special questionnaire has been prepared and used for this aspect of REACH. Different problem cases regarding the application of REACH article 6 on the imports into the European textile supply chain have been developed on the basis of the material from the interview partners. The results can be found in chapter 9.

8. **Reporting activities.** Apart from the two reports already mentioned, presentations of the work in progress and the (preliminary) results have been given to the REACH Impact Assessment Working Group (1 March and 13 April 2005), at the Luxemburg Presidency Workshop on REACH (10 May 2005) and at a validation workshop on 31 May 2005. The

latter event was aimed to present and discuss the outcomes of the study with textile chemicals and textile companies and with stakeholder representatives. The remarks and additional information from these venues have been taken into account in this final report. The executive summary which can be found at the beginning of this report has been presented to and discussed in the meeting on the High Level Group on the Competitiveness of the Textile and Clothing Industry on 14 June 2005.

3 Textile Chemicals in the European Textile Supply Chain

3.1 Introduction: a broad sketch of the European textile supply chain

The intention of this chapter is to provide a survey of the general shape of the European textile supply chain and the role of chemicals therein. In increasing levels of detail, we aim to portray the interactions of textile materials production and the associated textile chemicals input.

Textile production concerns very complex and intricate supply chains, which involve many stages and production companies, raw materials and intermediate products. Despite the complexities of real-life supply chains and the huge variation in textile end products (apparel in all its variations, home textiles, technical textiles and so on), the following five basic steps can usually be identified. These steps, depicted in Figure 3.1, are:

1. *Basic production (upper first part of the scheme)*

   a. In *agriculture*, the production of natural textile materials (cotton, wool, silk et cetera);

   b. In *chemical industry*, the production of synthetic textile materials (polymeric fibres such as polyester and polyamides).

2. *The production, dyeing and finishing of fibres and yarns (second part of the scheme)*

   This is one of the major input levels for textile auxiliaries and dyestuffs.

3. *The production of grey fabrics,* such as woven, knitwear, non-woven *(middle part of the scheme).*

4. *The finishing of fabrics and garments,* which consists of *pre-treatment, dyeing, printing, top finishing* and *coating (lower part of the scheme)*

   This is the main input level for textile auxiliaries and dyestuffs.

5. *The production of functional textile articles from fabrics* (CMT = Cutting, Making and Trimming) or compounds with other materials *(lowest part of the scheme).*

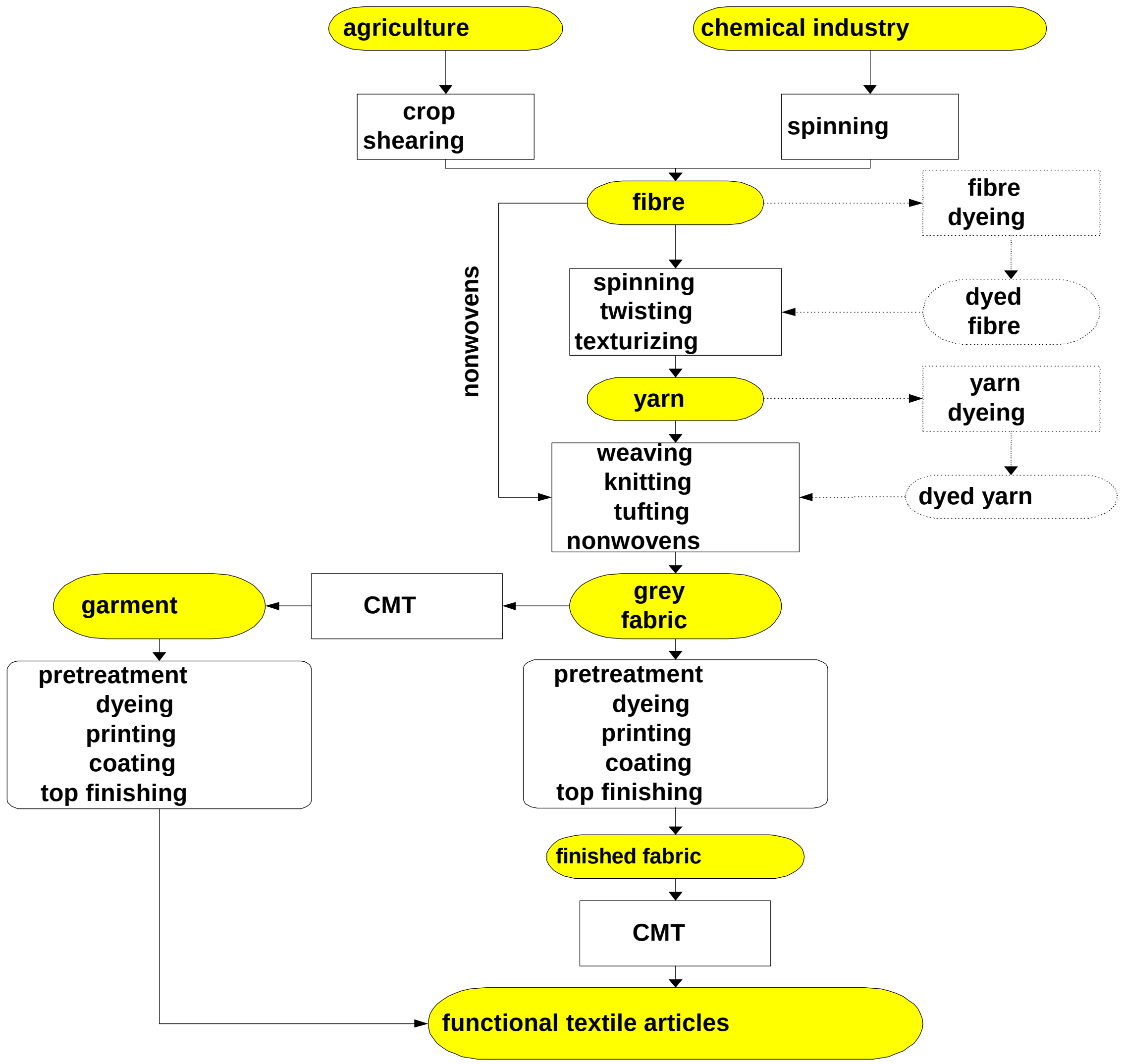

Figure 3.1: Principal structure of the textile value chain

At all stages of textile production and for many textile end products, the competition from outside the EU has significantly increased. In fact, most ready-to-use textile articles are currently mainly imported from outside the EU, largely from the Far East. For textile intermediates like fibres, yarns and grey fabrics, the interview results of this study confirm recent information from the European textile sectors that the largest part of these textile intermediates are non-EU imports. . Nevertheless, almost all EU Member States still have their own established production capacities regarding these textile articles.

The European textile industry has so far coped with this strong competition by an increasing reliance on those parts of the value chains where they can distinguish themselves through technological know-how and innovation, especially in the application of textile chemicals. These innovation efforts within the textile value chains have given European textile firms a valuable asset vis-à-vis firms which merely compete on costs and price.

The proximity and close ties between the European textile and chemical industries are particularly strong in the fields of R&D and in the development of innovative textile products. Close co-operation enables the swift and effective communication in the design phase of new products and shortens time-to-market. However, firms also need to guard the know-how of their own innovations in order to earn back their investment. As development cycles have become shorter and the demand for custom-sized solutions has strongly increased, especially in apparel industry with pressures coming from consumer fashions and from investment cycles from industrial textile users, this balance between communication and confidentiality has become more important. A disturbance to this process could have important consequences for the competitiveness of the European textile production.

The focus of this study is not on the whole EU textile production but on the finishing stage (yarn and fabrics/garments). This production phase contains process steps like pre-treatment, dyeing, printing and top finishing as well as coating. As will be shown in this chapter, it involves the largest use of chemicals in terms of tonnages and numbers and is therefore most relevant for the assessment of the impact of REACH registration obligations. Also, many innovative attempts in European textile industry find their starting point in textile finishing.

The two industries involved in the finishing of textiles and consequently falling within the scope of this study, the European textile chemicals and dyestuffs industry and the European textile finishing industry, will be described in more detail in the following sections 3.2 and 3.3, which are based on the desk research part of the study. The basis for this survey has been publicly available (statistical) data, the professional experience of the project contractors, discussions and interviews with the major industry associations like Euratex, Tegewa and ETAD as well as with the national industry associations and, last but not least, the results of the interviews with the selected companies from both industries.

Together, the sections 3.2 and 3.3 describe the chemicals supply chains that interconnect these two industries. Section 3.2 focuses more on the "chemical supplier" part of the supply chain; section 3.3 on the "downstream user" part. As regards the formulator stage of the supply chain, the sections demonstrate that this stage is for the most part not connected with the other stages of the chain through market transactions between different companies, but has been vertically integrated; partly upwards (textile chemical suppliers selling preparations called "packages"), partly downwards (textile finishers mixing "packages" into "recipes" for further use in their production processes).

The last section 3.4 summarizes the information on textile chemicals in the different stages of the chemicals supply chain of textile finishing.

3.2 The Textile Chemicals Industry

This chapter aims to highlight the important role of the European textile chemicals industry to the European textile production. It does so by taking a rather technical perspective, by describing the complexity of the chemical basis used for making of this wide variety of textile auxiliaries and dyestuffs used by the European textile finishing industry as well as the typical technical challenges in relation to REACH.

The data base used for this evaluation has been a very broad one. Major sources have been publicly available literature, the consultants' experience with this industry, particularly the results from previous research project as well as interviews with Tegewa and ETAD. One of the most important sources, especially concerning the detailed situation of single textile chemicals firms, has been the interviews with the textile chemicals suppliers which have participated in this business case study.

3.2.1 Basic facts

Definition of textile chemicals

Very often, textile chemicals are defined simply as chemicals used in textile production. The chemicals industry produces and sells three categories of textile chemicals such as

- *Basic chemicals* in terms of all kind of organic and inorganic substances,
- *Dyestuffs preparations*,
- *Textile auxiliaries for the different stages of textiles production* such as pre-treatment, dyeing, printing, top finishing and coating.

In this report, we will use the term "textile chemicals" as a catch-word for the last two categories; sometimes, it is used as a synonym for textile auxiliaries, which will then be clear from the context in which it is used.

The demand for *basic chemicals* is mainly satisfied by the basic chemicals manufacturers from all over the world, directly or indirectly through chemicals traders. Basic chemicals are not only used directly by textile producers; they also play an important role as inputs for the synthesis of the speciality textile chemicals which mainly represent the active ingredient of a textile auxiliary including all the dyestuffs (see further on below). Since these kinds of basic chemicals are mainly well-known commodities with high production volumes, they are supposedly not significantly affected by REACH. Consequently, they will not be subject of study in this report.

The textile chemicals manufacturers: producers of "active ingredients" and formulators of "*packages*"

The number of textile chemicals suppliers (excluding the basic chemicals producers) active on the internal market is estimated to be somewhere between 50 and 100 companies. The estimate is based on the interviews with and the provided data from Tegewa and ETAD.

These textile chemical manufacturers use a variety of basic chemicals substances - as already mentioned above - as the basis for their production of their textile chemicals. However, they rarely sell the produced substance in its pure form. These self-manufactured "*active ingredients*" are usually mixed with other, for the larger part purchased basic chemicals and subsequently formulated (to solutions, dispersions, emulsions) together with a solvent, mostly water. The word "active" in "active ingredient" concerns both active in the textile production process it is an input for, and active in the effect of the textile end product.

In this report, these marketed products will be referred to as "*packages*". Note that "packages" are in fact preparations and that consequently textile chemicals suppliers have integrated (a part of) the formulator stage of the supply chain. In fact, the competitive edge of textile chemical manufacturers lies in their know-how on making their own unique blend of a self-produced substance with other ingredients meant to enhance the effect. This can imply that a "package" contains more than one "active ingredient".

For a single textile chemical firm, the following estimated number ranges regarding the use and output of chemicals have been established from interviews with the selected textile chemicals suppliers and sectoral information:

- *Basic substances* used for synthesis and formulation 200– 2000

  (on average three different suppliers, 2 of which already from non-EU countries)

- *Self-made "active ingredient" in textile auxiliaries* 50 – 500

  (typically based on 2-4 basic substances)

- *Self-made "active ingredients" in dyestuffs* 50 -1000
- *"Packages"* 200 – 3000

  (i.e. preparations based on these "active ingredients")
- *Substances in one specific "package"* 5 – 30
- *"Package" linked to a single substance* 1 – 100

  (estimated average is about 5 – 10)

It is not possible to aggregate these estimates to the whole textile chemicals sector by simply multiplying them by the number of supplying firms, because the numbers are only indicative and because of the occurrence of multiple suppliers of a single substance and the occurrence of variation in technical grade in a specific textile chemical (later discussed in this chapter).

Another important outcome from the chemicals suppliers interviews is that *up to 90 % of the self-manufactured "active ingredients" are in the low volume ranges* of 1 to 100 tonne per year; with about the same number in each of the 1 - 10 and 10 - 100 tonne bands respectively (see table below).

Finally, through the interviews, only a few textile chemical substances (active ingredients) have been identified for the higher volume bands of 100 to 1000 tonne a year and over 1000 tonne a year, the latter on the whole only with the larger firms. This outcome does not say that high volume chemicals are not common in textile production; however, they mostly concern purchased basic chemicals, which are out of the scope of this study, as already mentioned at the beginning of this chapter.

The sales volumes of self-manufactured "active ingredients"

The following table presents the distribution of the single speciality (self-made) substances over the different volume ranges in dependency of the chemical company size as found in the business case interviews:

Volume range	small/medium firms	large firms
0-1 t/y	1-10	50-150
1-10 t/y	10-30	200-400
10-100 t/y	20-40	300-400
100-1000 t/y	5-15	50-150
> **1000 t/y**	0	1-5
Total	35-95	600-1100
1-100 t/a	30-70	500-800

Note 1: t/y is tonne per year

Note 2: the table figures are rounded

Note 3: the size indication refers to employment size

These interview results are in line with the consultants' experience and they have also been cross-checked with service documentations from other textile chemical suppliers. Due to confidential and sensitive nature of this business information only rounded ranges are given. The interviewed companies as well as the other textile chemicals companies contacted for this issue had already set up this kind of lists as part of their first preparations to REACH.

To avoid any possible misunderstanding concerning the definition of substances used here, the numbers of substances presented above concern only the self-manufactured "active ingredients" (speciality substances). All the other purchased textile chemical basic substances, the substances used for synthesis of textile chemical substances, polymers and/or chemicals added to the "package" formulations, were not scope of the study. However, there is sufficient evidence based on the experience of the project contractors that the basic substances used are typically located in the high to very high volume ranges, running from 1000 to 100 000 t/y. Often, their sourcing is already organized on a global basis.

Technical grade of self-manufactured "active ingredients"

This section deals with a special issue which may directly affect the REACH registration requirements of many textile chemicals. Specifically, this issue concerns some of the specific characteristics of these textile chemicals, more precisely the self-manufactured "active ingredients", that are relevant for the applicability of QSARs and other alternatives for testing such as read-across and also for the possibility for the consortia formation consortia (see section 6.2.3 for details).

Many textile chemicals (the "active ingredients" but in some cases also the "packages") coming from the textile chemicals industry are best characterized as *complex substances*, usually because of their *variety in technical grade*. In some cases, the chemical synthesis of the production process results in a concentration level of the intended active ingredient of only 20%, but pure grades up to 99 % are also possible. This variation of the concentration of the active ingredient and thus also of the other ingredients renders the substance complex.

These complex substances may pose two problems for the REACH registration process. Firstly, the current substance definition which allows for unintended by-products and impurities as well as for catalysts and other additives contains the implicit assumption that these only occur in low concentration ranges (as is nearly always the case for commodity basic chemicals). The occurrence of a wider range of technical grades is often indicated by the fact that *the same CAS number* (related to the main reaction product) *covers seemingly different chemicals* which are in fact a complex substance with widely varying technical grade and which consequently also differ considerably in their (complex) composition patterns.

Secondly, *this range of substances of technical grade* falling under one CAS number is likely *to generate a range of functionality in the textile finishing processes and as well a range in eco(tox)-testing results*. The latter could affect the applicability of computer-based alternatives to testing such as QSARs or read-across and may complicate the formation of registration consortia in the textile chemicals sector (see also chapter 6.2.3). This seems to contrast with the situation in the basic chemicals sector where substances show far less variance in technical grade, also when coming from different producers.

Actually, textile chemical experts regard the application of QSAR problematic for this kind of speciality substances of technical grade; this view was also expressed by the interviewed textile chemicals companies. Since QSAR applications exploit structure analogies in a group of substances, this method is suited for “pure substances” (as it is mostly the case with pharmaceuticals for example) or for a group assessment of commodity substances such as the glycol-(ethers) which are also used as components for textile chemicals. In the case of textile speciality substances, QSAR applications are thought to be severely hampered by the occurring composition variation of these substances, specifically due to their not very well defined by-products and impurities profile.

It is well known that un-reacted remains of input materials for the synthesis of a substance may contribute more to the toxicity of a substance than the substance itself in its “pure form”, with potentially dire consequences for the accuracy of QSAR predictions. Typical residual substance examples are formaldehyde, carcinogenic residuals as benzene, acrylonitrile and acrylamide, alkanolamines, other sensitizing starters as acrylates or diisocyanates, methanol et cetera. Similar problems have surfaced in attempts to forecast the eco-toxicological properties of surfactants with QSARs. In only very few cases, reasonable structure activity relationships could be found. Under these circumstances even the minimum QSAR scenario we used for the NPV analysis might underestimate the testing costs.

Annex 2 illustrates this problem of QSAR applications for complex substances with two typical examples:

- melamine “resins” based easy care products / cross-linkers
- fatty acid condensates based softeners

These examples concern substances from two of the six selected substances groups, as identified in Chapter 4. They will therefore be used in the chapters thereafter, mainly Chapters 6 and 7.

3.2.2 Description of major types of "packages" (the sales form of textile auxiliaries)

The fact that European textile chemicals manufacturers have (partially) integrated production and formulation stages of textile chemicals supply chains does not mean that these companies cannot act as pure formulators also. Almost of the textile chemicals companies bring formulations or "packages" on the market the ingredients of which they have not manufactured themselves. A minority of small textile chemicals firms operate solely as formulators. These firms have not been selected, because this study concentrates on complete textile chemicals supply chains of textile finishing, thus with all of the three stages, namely substance supply, formulating and downstream use. Moreover, these small formulators are not considered to be representative for the European textile chemicals business.

As will be further discussed later on, in the next section 3.3.5, most textile finishing firms also formulate textile chemicals with the purchased "package" formulations as a part of their own production process. Consequently, one can say that part of the formulating stage has been vertically integrated into textile finishing, but only if one stretches the definition of formulating somewhat so as to include making formulations out of other formulations.

There are four *major categories of textile chemicals "packages"* based on up to 30 "active ingredients" (self-manufactured and purchased):

- *Pure additive preparations.*

  These are mixtures of substances supplied by basic chemicals producers (such as solvents, emulsifiers, waxes, silicones and such). The functionality of the preparation is determined by the interaction of the components which reflects the actual formulation/application know-how of the formulator. These formulations are usually only critical for textile application processes, with flame retardants as the most well-known exception.

- *Preparations based on a particular self-made speciality substance.*

  The speciality substance (active ingredient) is synthesised with (purchased) basic chemicals. Together with other, purchased substances in minor concentrations, the speciality substance is dissolved or dispersed in water to make these preparations applicable to textile finishing processes. These substances/formulations usually are critical for textile-application processes and textile effects.

- *Preparations based on a self-made speciality polymer* (again based on (purchased) basic chemicals) which, together with other substances bought upstream in minor concentrations, is dispersed in water in order to make these preparations applicable to textile finishing processes. These formulations usually are mainly only critical for textile effects.

  As polymers are not covered by REACH, these preparations and their "active ingredient" are not further investigated in this study.

- *Preparations based on (complex) mixtures of other preparations*, coming from the same company or from other companies. These kinds of formulations provide textile finishers with a more or less ready to use *finishing recipe* (usually, only water must be added) and, therefore, constitute a special service to them. However, these recipes can make the finishers also more dependent on the know-how of their recipe supplier; they may also require transmitting finisher know-how to the textile chemical supplier. As already indicated above, textile finishing firms usually produce in a similar way their own ready-to-use "recipes" with the "packages" they have purchased from their textile chemicals suppliers.

Especially in the case of dyestuff packages solid preparations in powder form are also very common.

3.2.3 Survey of chemical substances found in textile chemicals and used for their manufacture

This survey presents four different items on the chemical substances which figure in the production and use of textile chemicals: the substance types used as active ingredients in textile chemicals "packages"; the basic substances used in the synthesis and formulation of textile chemicals; a survey of the self-manufactured active ingredients; and, finally, a description of dyestuffs.

Survey of types of chemical substances used for the manufacture of "packages"

This section concerns a global survey of the chemical substances types contained in the textiles auxiliaries and dyes (packages) which are being used in the European Textiles Industry. This survey is based on a majority of the textile auxiliary and dyestuff preparations used in Europe as described in the previous sections. The results which are reported in more detail (for the auxiliaries) in the Annex 3 to this report are used in Chapter 4 to identify groups of textile chemicals of critical importance.

The total number of basic substances used for the manufacturing (synthesis and formulation) of textiles auxiliaries and dyestuff preparations (packages) appears to be *significantly higher than two thousand, closer to three thousand.* However, as already mentioned in section 3.2.1, the number for a single company ranges from *200 up to 2000* substances depending of their size and variety of product portfolio. Unfortunately, based on the limited data available, the accurate number is hard to estimate because of the following reasons:

- Substances are provided by different suppliers
- Problems with substance definition (in-between and across variation in technical composition)
- It is not always clear which substances should be considered as polymers
- There is very little information on substances contained in imported preparations

- The role of relevant impurities and by-products in substances of technical grade

Substances contained in articles, textile intermediates as well as functional textile articles, have not been included in this estimation. Even though the "physical, chemical and textile technical rules" for the manufacture of chemical substances and their associated formulations are globally the same, imported articles may contain substances currently not registered in Europe under the existing chemicals legislation. The contacted chemical companies (for the business case interviews as well the business contacts exploited for this survey part of the study) confirmed the consultants' experience of the occurrence of such cases. This does not mean to say that these substances are not registered elsewhere, e.g. according to USA TSCA or Japan METI et cetera. However, due to the lack of regulation and information, these substances contained in imported preparations and articles may entail environmental impacts (through substances in imported textile intermediates) as well as more consumer safety risks (due to substances from imported ready to use articles especially apparel). These "substance in articles" related aspects will be further discussed in Chapter 9.

Basic substances for synthesis and formulation of textile chemicals

Based on the interviews and EnviroTex database (built on environmental impact studies on textile finishing plants; emission control measurements (air, water, workplace) related to textile chemicals and finishing plants; and various public research projects, all documented in Annex 1) some *1500* non-polymeric basic substances for synthesis and formulation of textile chemicals have been identified, such as:

- All kind of aliphatic and/or aromatic alcohols, glycol(ether)s, aldehydes, esters, ethers, hydrocarbons, carbonic acids, alkanolamines, ketones, amides;
- different kind of urea and melamine derivates;
- phosphonic and phosphoric acid esters ;
- halogenated aliphatic and aromatic hydrocarbons and ethers;
- various catalysts;
- many surfactants (polymeric and non polymeric);

- phthalic acid esters;
- many inorganic salts and substances;
- different biocides;
- perfluorinated aliphatic substances with different functionality.

Textile chemicals suppliers purchase most of these substances from chemicals suppliers out of the basic chemicals industry from all over the world (they also manufacture some of these substances themselves. On the one hand, in their capacity as formulators, they use these substances as components of preparations (textile auxiliaries and dyestuffs); on the other hand, in their capacity as textile chemicals manufacturers, they also use them for the synthesis of the "active ingredients" in the marketed "packages".

The self-manufactured "active ingredients"

A non-exhaustive list of the self-manufactured "active ingredients", based on the interviews with the chemical companies and also on the experience of the consultants, includes:

- fatty acid, amine condensation products with a variety of amines, alkanolamines, urea, formaldehyde, alcohols et cetera
- urea- and melamine-formaldehyde resins, etherified with different alcohols and glycols
- aliphatic, aromatic fatty acid esters
- quaternary aliphatic and aromatic ammonium salts
- special and modified surfactants
- Phosphonic and phosphoric acid esters

Based on the collected data from the interviewed companies, further information obtained from other chemical suppliers and the current EnviroTex data base, the number of these substances is roughly estimated to be in between *500 and 1000.* However, due to the earlier mentioned estimation problems concerning substance definition, the estimated range could shift with new information becoming available.

Dyestuffs as a sub-group of speciality substances

Finally, this list of substances has to be supplemented by supposedly more than 1000 dyestuffs (according to interviews with one of the interviewed companies and with ETAD, the dyestuff manufacturers association) which, as of now, we have not been able to categorize in a satisfactory way. However, the portfolio of the largest single dyestuffs producer contains about 1000 basic dyestuffs formulated to a larger number of dyestuffs preparations. Altogether the total number of dyestuffs formulations on the common market can be estimated to be about 5000 (based on the same information sources as mentioned above).

Dyestuffs may be classified according to their chemical composition or according to their performances in the dyeing processes. A *classification on the basis of chemical substance classes* is:

- Polyene and Polymethine dyes
- Di- and triarylmethine and Aza analogues dyes
- Aza[18]annulen metal complex dyes
- Nitro and Nitroso dyes
- Azo dyes (monoazo, disazo, et cetera)
- Carbonyl dyes
- Chinoide types
- Indigoide dyes
- Sulfur dyes
- Azo metal complex dyes

80 % of all textile dyestuffs are based on azo-dyes. *According to their performance in the dyeing process*, the following classification and distribution pattern is typical:

Dye type	Used on textile type	Share of textile dye volume
Disperse dyes	Polyester, acetate	21%
Reactive dyes	Cotton, viscose	24%
Vat and others		55%

3.3 The Textile Finishing Industry

This chapter highlights the pivotal role of the textile finishing industry in the European textile production, focussing on the use of textile chemicals. As done in the previous chapter on the textile chemicals industry, a rather technical perspective is applied, namely the complexity of the recipes used in the various finishing processes which is at the basis of the wide variety of European textile articles as well as the typical technical challenges in relation to REACH.

The data base used for this survey is a very broad one. Major sources have been publicly available literature, the consultants’ experience with this industry, particularly the results from previous research projects, as well as interviews with Euratex and some national textile industry associations. A particularly important input, especially concerning the detailed situation of single textile firms, has been the set of interviews with the textile finishing companies which have participated in this business case study.

The sections 3.3.1 to 3.3.5 will discuss the following aspects:

- Types of textile finishers
- The role of textile auxiliaries and dyestuffs in textile finishing
- Typical process and recipe structures and their complexity
- A broad sketch of the environmental fate of chemical substances in textile finishing
- The role of textile finishers as potential formulators

3.3.1 Types of textile finishers

Textile finishing plays a relevant role in practically all 25 EU member states. In the leading countries Italy and Germany, hundreds of such firms may be identified. In classical textile centers such as Prato in Italy and Northern Bavaria in Germany, dozens of textile finishing companies, most of them of SME size, are concentrated in a small area. There are broadly two different types of textile finishers:

- Commission finishers (dye and finish different textile materials in commission for a contractor (such as a weaver company) who remains the owner of the processed textile material)
- Integrated or merchant finishers (dye and finish their own textile material and sell it to the market or to manufacturers further downstream)

Both of them can be further divided into yarn- and fabric finishers versus garment finishers; the latter category has not been studied within this project (these are mainly larger companies).

In order to avoid potential misunderstandings, it should be mentioned that the term *finishing* is often used in a double sense. Normally speaking, *textile finishing* covers the whole process that starts with pre-treatment and ends with the final effect giving step; this last step is often also referred to as "*finishing*", whereas *top or special finishing would be the more accurate description*. In this study, in conformity with the usage in the textile industry, the term *finishing* will be used for both, unless the context could lead to a wrong interpretation.

The textile finishers use a wide range of textile chemicals/auxiliaries and dyestuffs as already indicated in section 3.2. Figure3.2 highlights the typical input of textile chemicals and dyestuffs along the textile fabric supply chain, by zooming in on the part of Figure 3.1 concerning the fabric finishing steps. Special emphasis is given to the step of top-finishing.

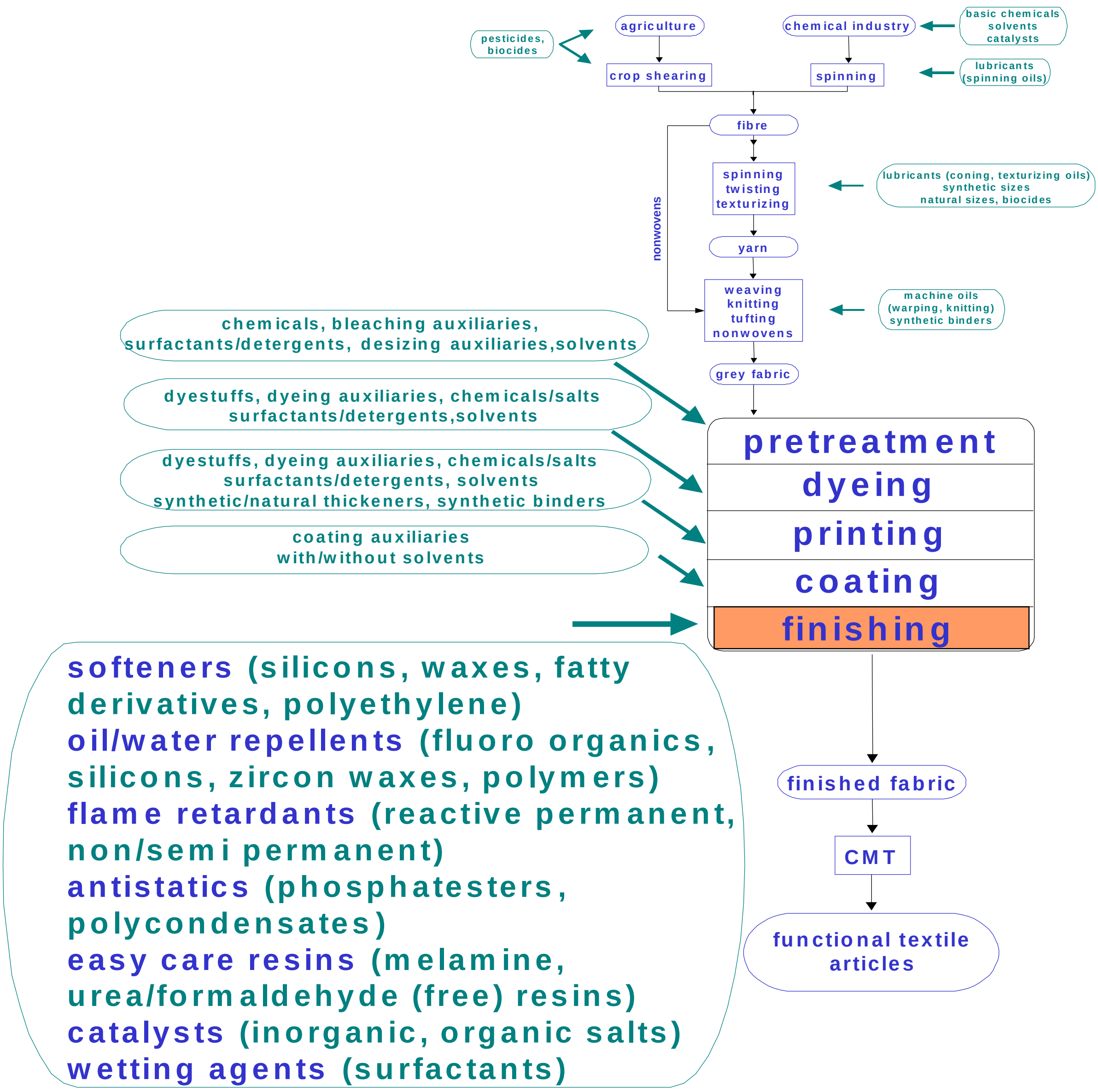

Figure 3.2: Major input points of textile chemicals into textile yarn/fabric production and fabric finishing

3.3.2 Survey of the use of textile auxiliaries: the pivotal role of textile finishing

The consumption of textile auxiliaries in the EU15 is estimated to be roughly 450 000 t/y in 2003.According to statistical data provided by Tegewa, the consumption of textile auxiliaries in the EU15 area in 2003 was about 300 000 t/y. However, from the interviews with Tegewa and textile auxiliaries suppliers (also in the context of the consultants' previous studies), together with the textile chemicals /dyestuffs purchasing lists provided by the interviewed textile finishing companies, we infer that Tegewa firms represent about two third of the total European textile auxiliary business.

In order to better understand the scale of the use of textile chemicals, it is instructive to set it off against the use of basic chemicals in EU 15 textile production, estimated to be in the range of 800 000 to 900 000 t/y . The latter concerns basic commodity chemicals such as salts, acids and alkalines. Section 3.2.3 provides a more detailed list of basic chemicals used in textile production. The estimate is based on the technical rules of thumb for textile finishing processes on the required mix of chemicals inputs, specifically the ratio between textile auxiliaries and basic chemicals of roughly 1: 1.8 to 1:2. The resulting range estimate is roughly in line with the results from an EnviroTex study in 1997 for the Austrian Ministry for Environmental Protection [8].

The table below subdivides the category of textile auxiliaries in groups according to their intended and foreseeable applications and related processes. The yearly volumes used in the EU15 textiles sector are estimates from Tegewa [9] again based on the assumption that Tegewa firms cover approximately two thirds of the total yearly turnover of textile auxiliaries in the EU15. The numbers of textile auxiliaries have been calculated from the Melliand textile auxiliary catalogue 2000 [10], with the figures in brackets coming from the above mentioned EnviroTex study for the Austrian Ministry of Environment [8]. Further below, we will give a short justification for both type of figures presented in the table.

Type of application	Tonnage (t/y)	Number of auxiliaries	
• Auxiliaries for fibre/yarn processing	40 000	600	
• Auxiliaries for fabric, knit wear and non wovens processing	40 000	500	
• Auxiliaries for pre-treatment	40 000	700	(100)
• Auxiliaries for dyeing	80 000		
		2600*	(540)*
• Auxiliaries for printing	40 000		
• Auxiliaries for finishing and coating	180 000	3350	(520)
• Auxiliaries for multiple uses	50 000	1650	
TOTAL	470 000	9400	

* Estimate for Dyeing and Printing combined

The tonnages in the table seem to be well in line with the volumes mentioned in other studies. The volume figures add up to a total of 470 000 t/y which is close to the overall estimate of 450 000 t/y discussed above. A plausibility check performed with the data of the mentioned Austrian study corroborates the tonnages in their relative proportions. The robustness of these statistical data is confirmed with estimates based on further data for Austria, namely through applying Austria's market share within the European textile processing industry of about 2 % [11] on the various segments of textile production. For example, corresponding to the Austrian top-finishing auxiliaries consumption in 1997 of 4 000 t/y, we would find a consumption in the EU15 of about 200 000 t/y. This is close to 180 000 t/y, Tegewa's estimation, certainly if one takes into account the well known recession of the textile auxiliary business in Europe since that time.

The number of substances mentioned in the table is derived from a count of the Melliand textile auxiliary catalogue 2000. The Melliand number has been corrected with a factor 1.5; this factor corresponds with the assumption mentioned above that Tegewa covers two third of the European auxiliary production in terms of tonnage and number of products on the market. This assumption is also corroborated in qualitative terms by the EnviroTex experience in the last years, specifically the EH&S services rendered to over hundred European textile finishers. We have regularly found non-Tegewa suppliers, especially small and medium chemical suppliers in Italy, France, Spain, UK, the Netherlands et cetera, which operate only on a local basis. The apparent deviations of the numbers found in the Austrian study (the figures in brackets) are mainly due to another way of aggregation, particularly in the group of dyeing auxiliaries which also contains many auxiliaries used for yarn and fabric after-treatment.

Note the tonnages of these auxiliaries do not constitute a reliable indicator of the environmental, health and safety impact from these substances for textile auxiliaries are usually complex preparations with a wide range of the water content (between 0 to 95 %) which varies over the different stages of textile production. For example, auxiliaries for fibre/yarn processing typically are highly concentrated whereas finishing chemicals typically are pretty diluted. The qualification “typically” points to the fact that in more than one case it is just the other way around. The variations in dilution imply that product price comparisons have to be handled very carefully.

However, *the table above clearly shows the preponderance of textile top finishing in the use of textile chemicals. About half of all textile auxiliaries are used in this final step of textile finishing*, if one realizes that the auxiliaries for multiple uses usually are applied in this finishing phase. The number of auxiliaries used in the various types of application better describes the situation than the figures on volumes due to the complication of using tonnages just mentioned.

Moreover, it is important to note that *textile top finishing is the vital step in bringing on the final effect for a textile component*. This is usually the kind of properties which the final consumer of the textile product value most - either as end user of an apparel product or as industry user in the case of a textile intermediate such as for example an automotive textile. This is why the textile auxiliaries used in textile top finishing are critical for the innovation potential and competitiveness of the European textile industry.

3.3.3 Typical recipe and process structure of textile finishers

Textile finishers usually use more or less complex "*recipes*" as the chemical basis for a yarn, fabric or garment finishing process. A *recipe* is typically based on a mixture of 2 to 10 textile auxiliaries/dyestuffs ("*packages*" as defined in section 3.2.1). The textile finishers usually buy the "packages" they need on the market and subsequently formulate themselves the required recipes with these "packages".

Usually, a specific finishing process requires different *recipes*, typically one for pre-treatment, dyeing, printing and top-finishing respectively. The result of such a finishing process is always a finished textile article with designedly specific properties. Every single article requires its own specific process using a specific mix of different *recipes* which depends on the composition of the textile article and its "grey" character as well as the intended final textile properties (mainly colour/print and textile effect). Consequently, there must be a very large number of such *recipes* used in textile finishing in order to help producing the millions of different textile intermediate articles.

As regards the process and recipe structure of the companies, the interviews with the textile finishing firms revealed the following number ranges per company:

• *Basic chemicals used*	10 – 40
• *Dyestuffs used*	50 – 200
• *Auxiliaries used*	50 – 200
• *Textile articles/processes*	1000 - 30 000
• *Recipes*	hundreds to 15 000

The large number of recipes (and consequently of processes) per firm results from the many possible combinations of basic chemicals, dyestuffs and textile auxiliaries, which are either individually added to the recipes or through the input "packages". Each combination is aimed to give the desired process or property effect.

As the rest of this study focuses on individual critical substances and their corresponding supply chains, only a few processes can be investigated more fully. Note however, that because of this combining effect of "recipes", *the preparations and recipes in the supply chain may very well contain more than one of the chosen critical substances*. In fact, this is what we have found in the supply chain identification which is reported in the following two chapters. In some cases, we have identified recipes which contain all of the selected critical substances. However, this phenomenon is not studied in-depth as it is out of the scope of the supply chain analysis.

The larger part of the variety in the finished textile articles as compared to the variety in "grey textiles" (input textile articles) is due to the difference in colours and shades. Pre-treatment *recipes* are few and more standardized, whereas the number of top-finishing *recipes* runs into the dozens to hundreds per company. These top-finishing *recipes* vary from rather simple structures with only two auxiliaries per *recipe* to more complex ones with up to fifteen components per recipe. Note that, it is well possible that dozens of colour shades or colours are linked to just one top-finishing recipe. Consequently, there is a risk that several colours could become unattainable in case one active ingredient in the associated top finishing packages becomes unavailable.

When focussing on a typical single production process line – e.g. pre-treatment, dyeing and top-finishing - *the use of up to 20 different textile auxiliaries and dyestuffs can be identified.* An analysis of the approximate chemical basis of the recipes (and underlying "packages") involved in the single value chains discussed in section 5.2 has identified *up to 700 substances*. 200 of them were intended, among which also some polymers; there are up to 500 unintended impurities and by-products from technical grade substances.

All of the 200 intended substances are more or less of critical importance as they warrant the general stability and quality of the single package as well as a specific part of the performance of the textile processes and effects. However, it is important to remark that the real number of the substances subject to REACH is certainly lower than this total of 200, since the given numbers also include polymeric substances such as most of the emulsifiers and surfactants. It is our professional opinion that the number of substances to be registered is still significantly high (in fact, the majority of those 200). However, this can only be clarified in a detailed assessment of all involved substances which falls out of the scope of the study.

The numbers mentioned above have only taken the *input* of chemicals to the production process into account. It is very probable that at least some of these 700 substances will chemically react with each other and/or with the textile material(s), depending on the actual parameters of the production process. Apart from creating new substances, these chemical reactions in the production process may also affect the distribution patterns of the release of residuals from final textile articles.

This illustrates that the accumulation of chemical substances in textile articles poses a serious challenge in the application of article 6 of the REACH proposal (on “substances in articles”). As a rule, it is harder to identify the substances contained in the imported textile articles for the reason that usually there is no full information on the earlier production processes and the corresponding chemicals inputs. This lack of knowledge on textiles articles, specifically grey fabric, is of interest because various environmental studies[1] show that the majority of substances which significantly contribute to the waste water and air emission from a finishing process are typically imported through textile intermediates like fibres, yarns and grey fabrics. This shall be outlined in more detail in the next section. Chapter 9 presents four problem cases regarding imports to the textile supply chain.

3.3.4 The environmental fate of textile chemicals: a broad sketch

This section aims to give a broad sketch on the environmental fate of the textile auxiliaries applied in textile finishing on the basis of the 1997 EnviroTex study on the Austrian textile industry [8]. Although this broad picture does not address the specifics of the relevant environmental, health and safety (EH&S) issues, it highlights the need for adequate EH&S

[1] See for some of them the EnviroTex list of studies in Annex 1.

management. It is also relevant for the REACH implementation, as it indicates the need for exposure scenarios covering and addressing these releases and manifold exposure situations.

The Austrian textiles study has found, to the surprise of some, that *by far the greatest environmental impact of chemical substances used in textile finishing* (including polymers) is *coming from the chemicals already contained in the so-called "grey textile"* which enters into the first textile finishing process step, the pre-treatment. A "grey textile" is usually defined as the unfinished fabric coming from the fabric manufacturing including all kinds of textile chemicals used and accumulated in the previous fabrication steps as yarn finishing and fabric making (mainly sizes and lubricants). This interesting fact points to the "substances in article" issues of textile intermediates, fibre/yarn or fabric, since "grey textile" is for the largest part imported from outside the EU, notably the Far East.

The Austrian study illustrates the environmental relevance of the issue by demonstrating that up to 90% of the impact in pre-treatment is coming from substances released out from the grey textile article and thus only 10 % from the auxiliaries used for the process. This pointedly contrasts with the seemingly high input volumes of top-finishing auxiliaries. These relatively watery packages, however, contribute to the environmental impact in a far lesser degree. To illustrate this point: they account only for about 2 % of the actual consumption volume of the related textile auxiliaries, whereas about 20 % of this amount stays on the final textile product in the form of mainly cross-reacted polymers or single substances.

This study also says where these imported substances in grey textile articles typically come from. These are mainly from imported fibres, yarns and fabrics which may contain textile chemicals up to 10 % of total weight.

3.3.5 The origin of preparations used by textile finishers: purchases and own formulating activities

The interviews with the textile finishing firms confirmed the observation that the majority of auxiliaries and dyestuffs on the European market are *supplied by a limited number of mainly* *large and medium chemical producers*, located in Europe (see section 3.2.1). Most of them are members of the German industry association Tegewa. Supplies also come from smaller trades and particular chemicals producers, which both are usually located in the neighbourhood of the textile finisher.

The textile finishers *buy most of the textile chemicals in the shape of a "package"*, which is a preparation of one or more active ingredients, together with a solvent and other chemicals meant to enhance specific process and product effects. *All the interview partners indicated that they usually formulate themselves the recipes they use in their own specific finishing processes from the packages and substances bought from their suppliers.*

Some (textile) chemicals have a clear non-European origin. Textile finishers usually get these textile chemicals from chemical traders. Through one of the interviews, a chemicals trader has been identified which imports chemicals from China, namely DPDPO and Antimonytrioxide for flame retardants. The importer itself is not a textile finishing firm but a chemicals trader which has the same nationality as his customers. According to the interviewed textile finisher, the trader was hardly aware of REACH. This interview also revealed that some textile finishers have learned to produce their own innovative flame retardant formulations, based on the imported chemicals. This confirms the observation that textile finishers also engage in formulator activities, however, almost always for use in their own production processes.

The interviewed textile finishing firms expressed their concern that such self-formulated recipes could fall out of the scope of the exposure scenarios of the chemical suppliers and that consequently they would have to notify their use to the Agency and potentially carry out other downstream obligations without the technical assistance of their suppliers. Part of this perceived risk had to do with their own desire to keep their specific use of the chemical confidential, the very reason they had engaged in the formulating activities in the first place. These downstream user aspects are further discussed in chapter 8.3.

3.4 Summary: The chemicals supply chain in textile finishing

The previous two sections have discussed in detail the production and use of textile chemicals, focussing on the textile chemicals and textile finishing industries. The results of this survey have been fed back to the interviewed European and national industry associations and some of the interviewed firms. Based on their reactions and our own market experience built up over two decades, we are confident that we have reviewed more than 80% of the textile chemicals market in EU and that consequently Figure 3.3 gives a realistic picture of the European wide linkage between textile chemical substances, their associated preparations and the finishing recipes.

The figures mentioned in the diagram can be traced back to the survey of this chapter. The 1500 basic chemicals (excluding polymers) and the 1500 specialty substances are reported in section 3.2.3. The latter figure is the sum of the estimated number of the self-manufactured active ingredients (500 to 1000) and the number of basic dyestuffs (1000). The 15000 textile chemical preparations (the "packages") reported here include dyestuffs and textile auxiliaries. It is an estimate derived from an interview with ETAD (5 000 dyestuff preparations in Europe) and around 10 000 textile auxiliaries (as before based on 1,5 times the Melliand catalogue [10] number of about 7000 textile auxiliaries produced by Tegewa firms). The maximum number of recipes per textile finisher is reported in section 3.3.3.

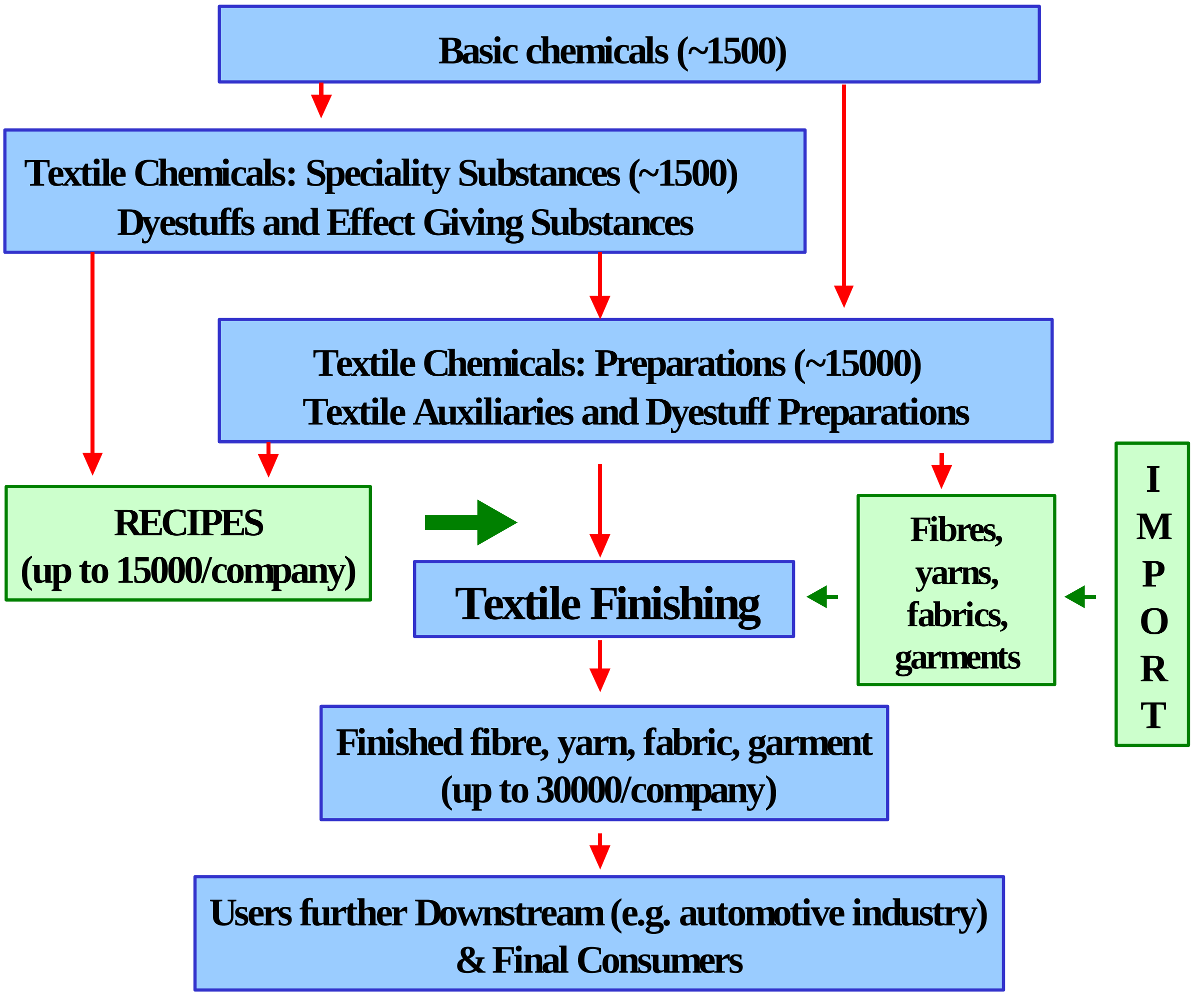

Figure 3.3: The chemicals supply chain in textile finishing

4 The identification of groups of substances critical to European textile production

4.1 Methodology

The survey of the textile chemicals from the previous chapter, especially the lists reported in section 3.2.3, has served as the basis to identify six groups of substances which are of critical importance for the European textile finishing industry, the most intensive user of textile chemicals within the European textile industry[2]. This grouping is representative as the selection has been carried out on the basis of clear criteria which have been discussed in advance with the technical experts of the national textile associations, members of Euratex, as well as textile chemicals suppliers, members of Tegewa.

There are three major technical criteria for the definition of a critical substance (group)

- A substance which plays a crucial role in a production *process* step, e.g. it enables the dyeing of a synthetic fibre as a dyeing carrier or it acts as a cross-linker to fix other substances on a fibre.
- A substance plays a significant role in a textile auxiliary as it provides a unique or typical *effect* on the product, e.g. substances that like as a flame retardant, easy care, softening.
- A substance plays an important role as an *additive* in an auxiliary formulation providing the preparation with a required physical property for later applications, storage and transportation stability, et cetera e.g. substances that serve as an emulsifier, a biocide, an anti freeze agent.

Only the first two criteria have been applied in this study because these are directly relevant for textile industry, in particular textile finishing. Combined they have led to a grouping

[2] As has also been shown in the previous chapter, within textile finishing top finishing is the most important specific user of chemicals.

based on the *function* of the critical substance rather than the chemical basis proper. The latter has been used to define the various sub-groups. Consequently, single substances out of the main group can have completely different chemical bases, but within a certain sub-group the chemical basis is similar.

The group names do more refer to the various types of packages than to substances. In fact, instead of "substance groups", the term "package types" would have been more apt, also because the marketed textile chemicals are mostly not substances but these kinds of preparations. The sub-group names naturally refer to the chemical basis of the "active ingredient" of the package, also called "critical component", the substance in the package which accounts for the critical effect.

The textile auxiliary group of "softeners" can illustrate the principle at work. The "softener" group consists of the different critical substance groups available for the production of softeners, namely fatty acid condensation substances, paraffin substances, silicone substances and some less important ones. Textile finishers need this wide tool box in order to provide the precise softening effect required for the different article types (such as yarn or fabrics, all kind of different textile materials such as polyester or polyamide), but also with a view to the various performance aspects, such as the duration of the effect or the compatibility with other effects on the same material. For further fine tuning of the intended softening effects, it is helpful to form sub-groups on the basis of the chemical structure. This leads to chemicals sub-groups such as fatty acid condensation products, silicones, paraffins with different chain distributions et cetera.

For the purposes of this study, it is necessary to choose functions which are very common to textile finishing. There are two basic methodological reasons for concentrating the attention to this kind of functions. Both of them are related to the application of the supply chain methodology documented in the methodology paper of the IPTS study [7]. The IPTS approach to identify significant real-life supply chains has been chosen as point of reference, as it takes the formulator and his preparations as starting point. The pivotal role of the "packages", marketed by the suppliers of textiles chemicals and purchased by the textiles industry suggests a similar approach.

The first methodological reason to select textile chemicals which perform common functions in textile finishing is that it constitutes the logical first step in selecting "key packages". It is rather evident that these "key packages" must be commonly used in textile finishing in order to have critical importance for the textile finishers and consequently for textile chemical suppliers. Of course, it is understood that not all preparations in these groups are "key packages"; however, the grouping is just the first step in the selection process. The next chapter will detail how "key packages" have been selected out of the groups.

The second reason has to do with the further steps in the selection of the critical substances and the identification of the corresponding real-life supply chains. In this step, we have deviated from the IPTS approach. Rather than a specific critical preparation, a basket of critical components has been taken as starting point. This approach tries to make good use of the specific characteristics of the textile sector, namely that in the textiles production process, the critical "active ingredients" are present in quite a few "packages" and consequently in numerous recipes used in many preparations at various stages of the process, whereas the specific chemicals of these preparations come from just a few chemicals suppliers.

4.2 The selected critical substance groups

This chapter lists the basket of the six selected groups of critical preparations including their selected critical chemical components sub-groups. After an overview of the six groups, we will discuss per group the arguments for their selection according to the IPTS criteria for the definition of key preparations/substances and for their potential vulnerability of being withdrawn from the market for commercial reasons, of course from a rather global perspective. The term "potentially vulnerable" as used here should not be confused with the "vulnerability" of the ultimately selected critical substances; this term belongs to the economic analysis reported in chapter 6. Per group, also the estimations of the volume and price ranges will be given, as well as the number of producers. All the information is based on contacts with textile chemicals suppliers in the survey phase of the study.

One has to be aware that the given price estimations are related to the preparations except for the glycols. We could not provide the real prices of the critical substance contained in its formulation at this early stage of the substance selection process without having performed the case study itself. Also, since it is common that textile chemical manufacturers do not sell the critical substance in its pure form, but only as part of a preparation (a "package"), these critical substance prices would not be the actual market prices but "virtual" prices, calculated on the basis of assumptions on the attribution of costs and gross margin. However, it is possible to give a raw estimate of the critical substance price: due to the dilution range of the substances (10-50%) and their assumed leading character in a preparation, the prices for the pure substance might be significantly higher, supposedly 2-5 times.

As explained in the previous section, the groups can be characterised by their critical component type or by the catch phrase of the "package" preparation in which the critical component is sold by the chemicals manufacturer. These are:

	"Package" type	Critical component type
1.	Softeners	fatty acid condensation products
2.	Easy care products/ cross-linkers	melamine resins or DMDHEU derivatives
3.	Dyeing carriers	benzylbenzoate
4.	Cotton dyestuffs	reactive dyes
5.	Synthetic fibres and yarns lubricants	fatty acid esters
6.	General formulation solvents	glycol(ether)s

The first four of these groups have been used to map out actual supply chains described in chapter 5 and to select specific critical substances for a detailed analysis. The last two groups have been held in reserve.

The technical and logistical position of these substances within the textile value chain is shown in Figure 4.1.

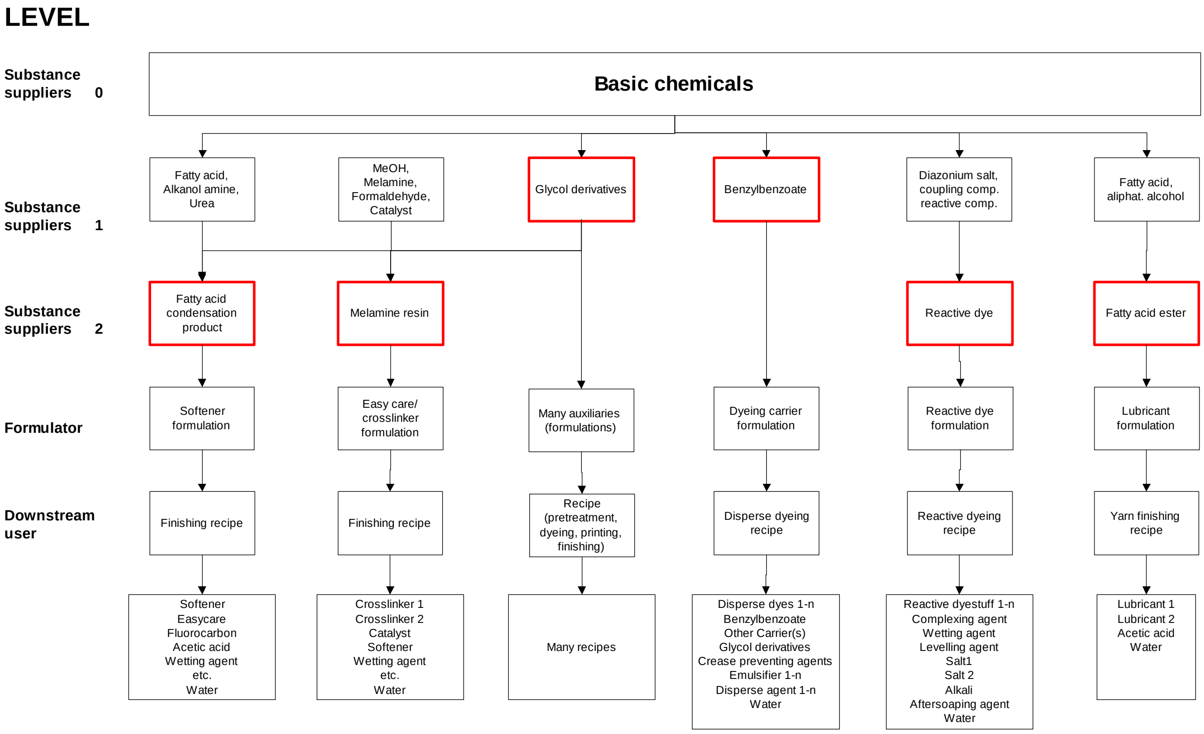

Figure 4.1: Technical and logistical position of the substances

The characteristics of the groups and their reason for selection are respectively:

1. Softeners based on fatty acid condensation products

Fatty acid condensation products concern those with alkanol-amines and polyamines as Ethanolamine, Diethanolamine, Triethanolamine and Ethylen-diamine, Diethylenetriamine and/or -urea as synthesis basis.

Estimated price range	1-3 Euro/kg for formulation
Estimated volume range	1-1000 t/y
Estimated number of producers	10-30

Softeners represent one of the most important groups of textile auxiliaries (preparations) which are critical to the performance of the final textile product due to their wide application grade as described in the example of section 4.1, especially in the apparel sector. In many cases, they also fulfil the criteria of a key preparation for a textile auxiliary producer (formulator). Softeners are as a group potentially vulnerable to withdrawal since many softeners have low production volume (though higher production volumes can be found as well) and/or relatively low prices and profit margins.

The active softening component can be based on many different chemical substances. The selected chemical basis of the fatty acid condensation products represents only one group as already mentioned in section 4.1. Moreover, just within this group there are many variations in the actual chemical composition. Thus, at the end of the supply chain, a single type of these substances will probably be used in only a few preparations and supplied by only a few substance producers. Therefore, if one encounters one of these specific substances at the sales list of a textile chemical supplier and at the purchase list of a textile finisher, there is a high probability that one has traced the both ends of a really existing supply chain.

2. Cross-linkers/Easy care products based on melamine resins or DMDHEU derivatives

Melamine resins as well as DMDHEU resins differ in etherification grades and formaldehyde contents.

Estimated price range	1-3 Euro/kg for formulation
Estimated volume range	1-1000 t/y
Estimated number of producers	10-20

Both selected types of critical components, melamine resins and DMDHEU resins, are the basis of a very important group of textile auxiliaries. On the one hand, they are used for easy care finishes and coating of non-wovens mainly and on the other hand as cross-linking agents. Consequently, they are per definition critical to the performance of the final textile product (no more ironing needed) as well as to the performance of a finishing process (helping to improve the permanency of a finishing effect as flame retardation, water repellence, et cetera). These selected preparations are potentially vulnerable to withdrawal since many of them have low production volumes (though high volumes are found as well) and/or relatively low prices and profit margins.

The active component can be based on many different chemical substances. The selected critical component types represent only two groups. However, already within these groups, there are many variations in the actual chemical composition. Thus, at the end of the supply chain, a single type of these substances will be used in only a few preparations and will be supplied by only a few substance producers. Therefore, if one encounters one of these specific substances at the sales list of a textile chemical supplier and at the purchase list of a textile finisher, there is a high probability that one has found the both ends of a real-life supply chain for these kinds of critical.

3. Cotton dyestuffs based on reactive dyes

Estimated price range	10-20 Euro/kg for formulation
Estimated volume range	1- >1000 t/y
Estimated number of producers	10-20

Reactive dyes represent one of the most important groups of textile dyestuff preparations. They are critical to the performance of the final textile product due to its wide application grade in nearly all kind of textile sectors. In many cases, they fulfil the criteria of a key preparation for a textile dyestuff producer (formulator). Many reactive dyes are potentially vulnerable to withdrawal as they have low production volumes (though very high volumes are found as well). The active dyestuff component can be based on many different chemical substances. A typical trait of reactive dyestuffs is that there are many different types in use in just small amounts in order to achieve the appropriate colour nuance. Consequently, a single type of these substances will be used in only a few preparations and will be supplied by only a few substance producers. Therefore, if one encounters one of these specific substances at the sales list of a textile chemical supplier and at the purchase list of a textile finisher, there is a high probability that one has found a real-life supply chain within this substance group.

4. Dyeing carriers with critical components such as benzylbenzoate

The critical components taken into the original selection are: benzylbenzoate, biphenyl, phthalimide, chlorobenzene/toluene, o-phenylphenol, aromatic hydrocarbons, and phthalates.

Estimated price range	2-4 Euro/kg for formulation
Estimated volume range	1-1000 t/y
Estimated number of producers	1-5

Dyeing carriers represent one of the most important textile auxiliaries (preparations) which are critical to the performance of the textile finishing process. Without them, most of the synthetic polyester fibres dyeing would not be possible. In most cases, they also fulfil the criteria of a key preparation for a textile auxiliary manufacturer (formulator), especially if he sells dyestuffs together with the carrier formulation. Many dyeing carriers are potentially vulnerable to withdrawal as they have low production volumes (though high volumes are found as well) and/or relatively low prices and profit margins.

The active component can be based on many different chemical substances, as listed above. Consequently, it is likely that a single type of these substances will be used in only a few preparations and will be supplied by only a few substance producers or importers. Therefore, if one of these specific substances is found at both the sales list of a textile chemical supplier and the purchase list of a textile finisher, there is a high probability that one has identified the both ends of a real-life supply chain within this substances group.

4. Synthetic fibres/yarns lubricants based on fatty acid esters

Estimated price range	2-5 Euro/kg
Estimated volume range	1-1000 t/a
Estimated number of producers	1-5

Lubricants represent one of the most important groups of textile auxiliaries (preparations) which are critical to the performance of the fibre/yarn processing step. In most cases they also fulfil the criteria of a key preparation for a textile auxiliary producer (formulator). Many lubricants are potentially vulnerable to withdrawal as they have low production volumes (though high volumes are found as well) and/or relatively low prices and profit margins. The selected chemical basis, namely the fatty acid ester products, represents only one of the many sub-groups, as the active lubricant component can be based on many different chemical substances. However, even within this group of fatty acid esters, there are many variations in the actual chemical composition. Consequently, a single type of these substances will be used in only a few preparations and will be supplied by only a few substance producers. Therefore, if one encounters one of these specific substances at the sales list of a textile chemical supplier and at the purchase list of a textile finisher, there is a high probability that one has found a really existing supply chain.

6. General formulation solvents based on glycol-(ethers)

The glycols and glycol-ethers in question include ethylene-glycol, diethylene-glycol, triethylene-glycol, propylene-glycol, dipropylene-glycol, tripropylene-glycol and all their methyl-, ethyl-, propyl-, butyl-, phenyl-ethers as well as their ether-acetates.

Estimated price range	2-6 Euro/kg
Estimated volume range	1-1000 t/a
Estimated number of producers	1-5

The selected chemical substances described as general formulation solvents are used as an important formulation basis of most of the textile auxiliaries used in textile finishing industry. Consequently, they can be found in auxiliaries used for pre-treatment, dyeing, printing, special finishing, dyestuffs as well as preparations for fibre and yarn processing. Their function is to improve the applicability of the associated textile auxiliaries, specifically the recipe stability, the wetting behaviour, the particle size distribution of dispersed polymeric substances or pigments, the migration behaviour of dyestuffs, formaldehyde binder et cetera. Consequently, they are critical to the performance of many textile chemicals (“packages”): the withdrawal of just one of these glycol/ether substances could endanger a whole group of preparations even if they come from different textile chemical suppliers. As a consequence, thousands of recipes in textile finishing industry based on these preparations could be endangered as well. The probability to find a real existing supply chain for these substances within the selected project partners is very high.

Due to their wide range of use as general formulation agent, there is also a very high chance to find this kind of critical substance in the same preparation(s) as the critical substances from the other groups.

For this group, pure formulator companies seem to be quite natural, maybe still existing in the EU. This has been a reason that this group has been kept in reserve for the next selection steps.

5 Mapping out real-life supply chains

5.1 The selection of appropriate textile chemicals and textile finishing companies

In the selection of companies for participation in the study according to the terms of reference we have taken special account of the need to involve a minimum number of firms, geographical spread, different company sizes including a number of SMEs and covering different parts of the textile industry as apparel, home and technical textiles. The availability of firms for the study has of course been facilitated by stakeholders. Further, required by the methodology the selected companies should provide a wide product and process portfolio, a high probability to match the 6 selected critical substances respectively substance sub-groups and the willingness and capacity to participate on short notice.

5.1.1 The selection of textile chemicals companies

The following 4 companies have participated in the business case study:

- One small-sized manufacturer from a NMS country
- Two medium-sized manufactures from Germany
- One large non EU manufacturer importing to the EU

In fact, 5 producers of textile auxiliaries had been selected and invited to participate in the project. This original selection was meant to fully reflect the distribution of output in the textiles auxiliary sector. However, due to organizational problems which had got in conflict with the time line of the project, a selected large Italian textile chemicals company ultimately had to decline the invitation to participate. No information from this company has been used for the business case studies.

To be absolutely sure that the remaining selection of 4 companies was appropriate to the case study objectives, these firms had to confirm in advance that they manufacture and/or use the selected 6 critical substances groups for formulating their associated preparations and sell these to a significant number of European textile finishers and regions.

Nearly all selected textile auxiliary/dyestuff manufacturers provide a gamma of preparations wide enough to cover all stages of textile processing (pre-treatment, dyeing, printing, top-finishing, coating). This appears to be an essential requirement of the textile chemicals business as it enables to provide maximum process and system service However, some of the companies show a certain specialization in sub-sectors as fluoro-chemicals, flame retardants, lubricants, biocides, surfactants, dyestuffs et cetera which is also indicated in Figure 5.1.

5.1.2 The selection of textile finishing companies

As reported in Table 5.1 and Figure 5.1, 9 textile finishing companies have participated in the business cases, out of an original selection of 11 companies, based on the selection criteria mentioned at the beginning of the chapter. These 11 textile firms had already expressed their willingness to participate in the project.

Based on the company descriptions as recorded in Table 5.1, there was sufficient evidence to expect that we would find importers of articles (textile intermediates and/or ready to-wear/use) among the selected firms. This expectation has been confirmed during the interviews as we have identified two companies which import from outside the EU.

Further, prior to the interviews we asked the invited 11 textile finishers to prepare and to make available in advance to the interviews

- A list of maximum 15 leading processes/recipes with emphasis on the predefined critical substances/substance groups
- Their textile chemicals consumption list
- A description of the associated textile finishing processes

This was only partly successful; however, the result provided sufficient confidence to the consultants that the needed input data for the business case study would become available in a reasonable quantity and quality.

During the interview phase 2 companies (one SME and one large firm, neither of them an importer of textile intermediates) out of the 11 selected cancelled their earlier confirmation of a full participation due to unexpected internal economic problems and reorganizations. However, both companies provided some basic data (by phone and e-mail) about the number of recipes used the number of textile articles produced, and the recipe reformulation situation (costs and numbers). These data have been used for the case study.

There was no more time left in this project phase to identify and interview alternative project partners. However, it had than already become clear that the project tasks would most likely not suffer from these cancellations, as a sufficient amount of study material from textile finishers had already become available.

5.1.3 The linkage of the selected project partners

Figure 5.1 illustrates how the different selected project partners (including the firms which cancelled their participation as mentioned above) are linked to each other through the selected critical substances and their associated formulation types. Bold arrows indicate where we have established whether a substance/substance sub-group in form of their associated formulation is being used by a certain textile finisher. The other arrows indicate there is a high probability that the indicated links are true.

In the following table all selected textile finishing companies are described in more detail regarding their economic and technical profile.

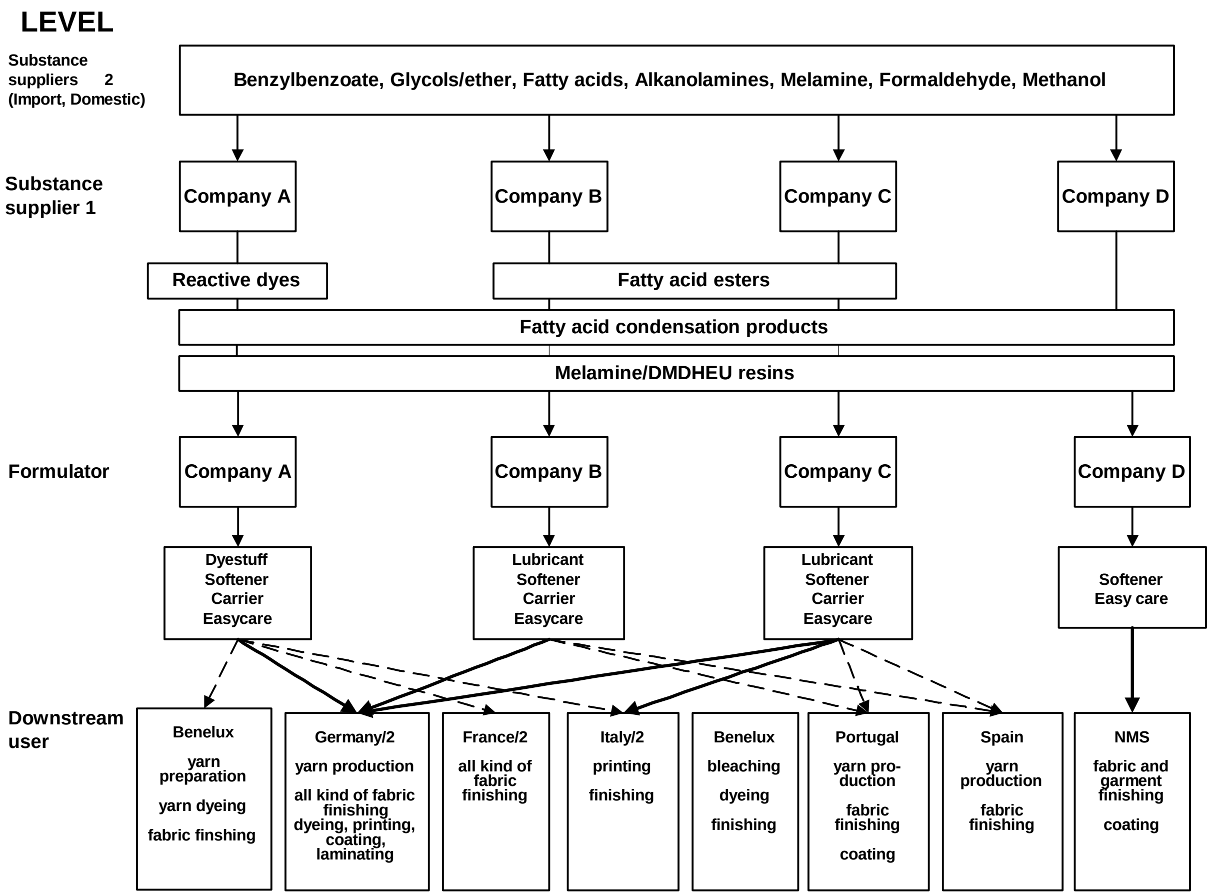

Figure 5.1: Planned linkage of project partners

Country	Company	Contact Person	Activity	Size	Participation status in the business case study
BeNeLux	confidential	confidential	commission finisher and yarn dyer	SME	Full
NMS	confidential	confidential	speciality chemicals producer, formulator, textile finisher, technology transfers, eco-services	SME	Full
France	confidential	confidential	merchant finisher	SME	Basic data contribution per e-mail
France	confidential	confidential	merchant and commission yarn finisher	SME	Full
Germany	confidential	confidential	integrated yarn a fabric finisher	large	Full
Germany	confidential	confidential	commission fabric finisher	large	Small data contribution by verbal communicatio n
Italy	confidential	confidential	printing	SME	Full
Italy	confidential	confidential	Commission fabric finisher and dyer	SME	Full
BeNeLux	confidential	confidential	commission and merchant fabric finisher	SME	Full
Portugal	confidential	confidential	fully vertical textile group	large	Full
Spain	confidential	confidential	integrated yarn and fabric finisher	large	Full

Table 5.1: Selected companies

5.2 The description of the real-life supply chains

Following five real-life supply chains based on the pre-selection strategy of chapter 5.1 have been mapped out. Finally 6 different single critical substances (including 2 of the same critical substances group out of the basket of the six pre-defined main groups) were selected according to the availability, completeness and reliability of input data needed for the full business case studies.

Substance	Substance group	Tonnage band
Fatty acid condensation product A	Softeners	10 - 100 t/y
Fatty acid condensation product B	Softeners	10 - 100 t/y
Melamine resin	Easy care products/ Cross-linkers	100 -1000 t/y
Benzylbenzoate	Dyeing carriers	100 -1000 t/y
Reactive Dyestuff “Brown”	Cotton dyestuffs	10 - 100 t/y
Reactive Dyestuff “Black”	Cotton dyestuffs	>1000 t/y

Due to reasons of confidentiality, the full (brand) names of the critical substances cannot be revealed.

The substance groups “glycol(ether)s” and “synthetic fibre and yarn lubricants” have not been further regarded, as the matching process in the other four groups had been fully successful in identifying real-life supply chains with critical substances.

Finally 3 of the participating chemical firms (out of 4) and 3 of the fully participating textile firms (out of 9) could be linked to the 5 real life supply chains. The actual links are marked in Figure 5.2.

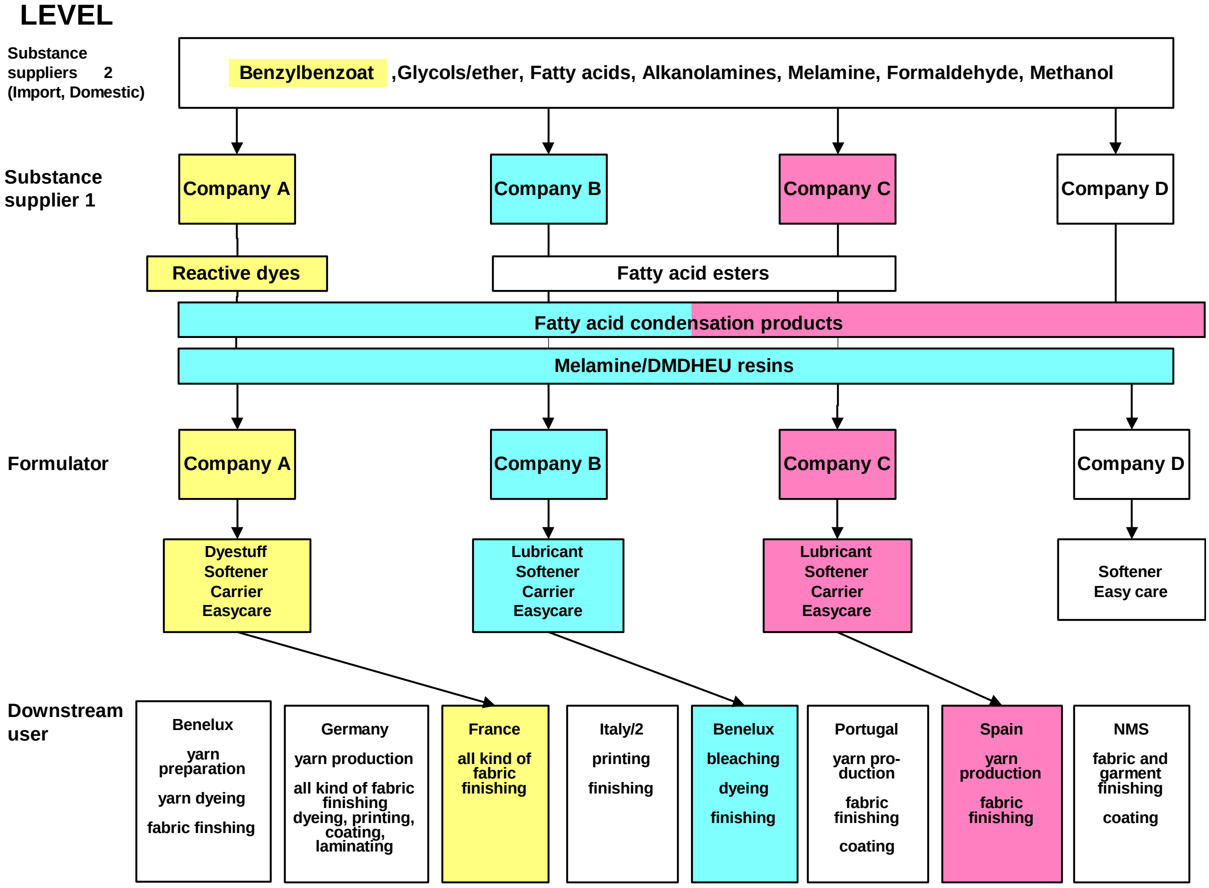

Figure 5.2: Actual linkage of fully participating project partners

In Figure 5.3, an example for such a real supply chain is illustrated showing all participants in this special case. Based on the available information from the single interviews, this kind of picture could be principally drawn for all five supply chains.

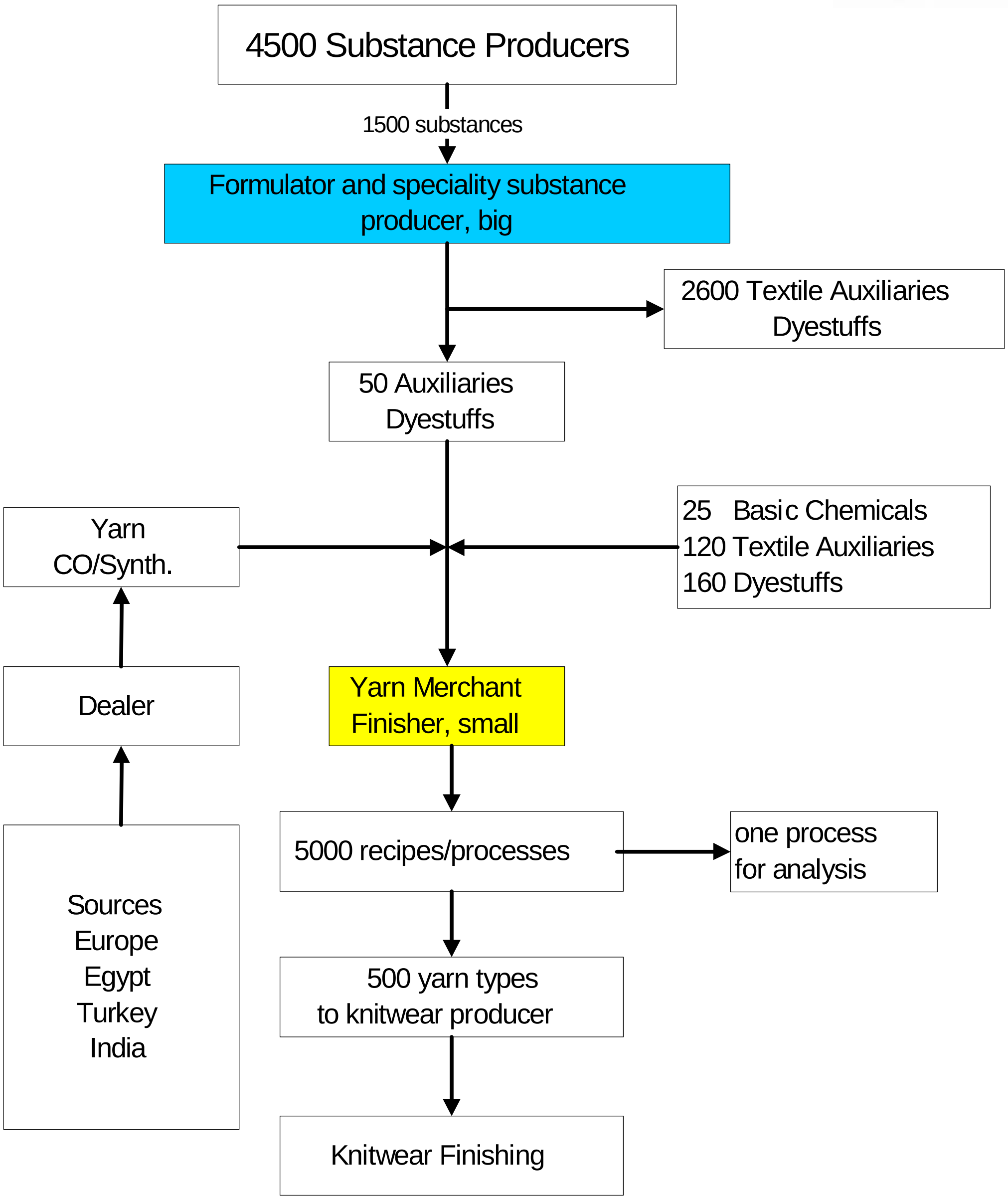

**Figure 5.3: Typical real life value chain
(Yarn finisher and large chemicals manufacturer/importer)**

5.2.1 The textile supply chain with the critical substance benzylbenzoate

The identified benzylbenzoate supply chain ends with finishing of PES/PAN yarn. This includes a non EU textile chemicals and dyes manufacturer and a French yarn finisher. It is part of the value chain complex depicted in Figure 5.3, in fact singling out only one process out of 5000 of this finisher. Figure 5.4 highlights the full process details and shows the position of the selected critical substance of interest (**benzylbenzoate** as component of a dyeing carrier).

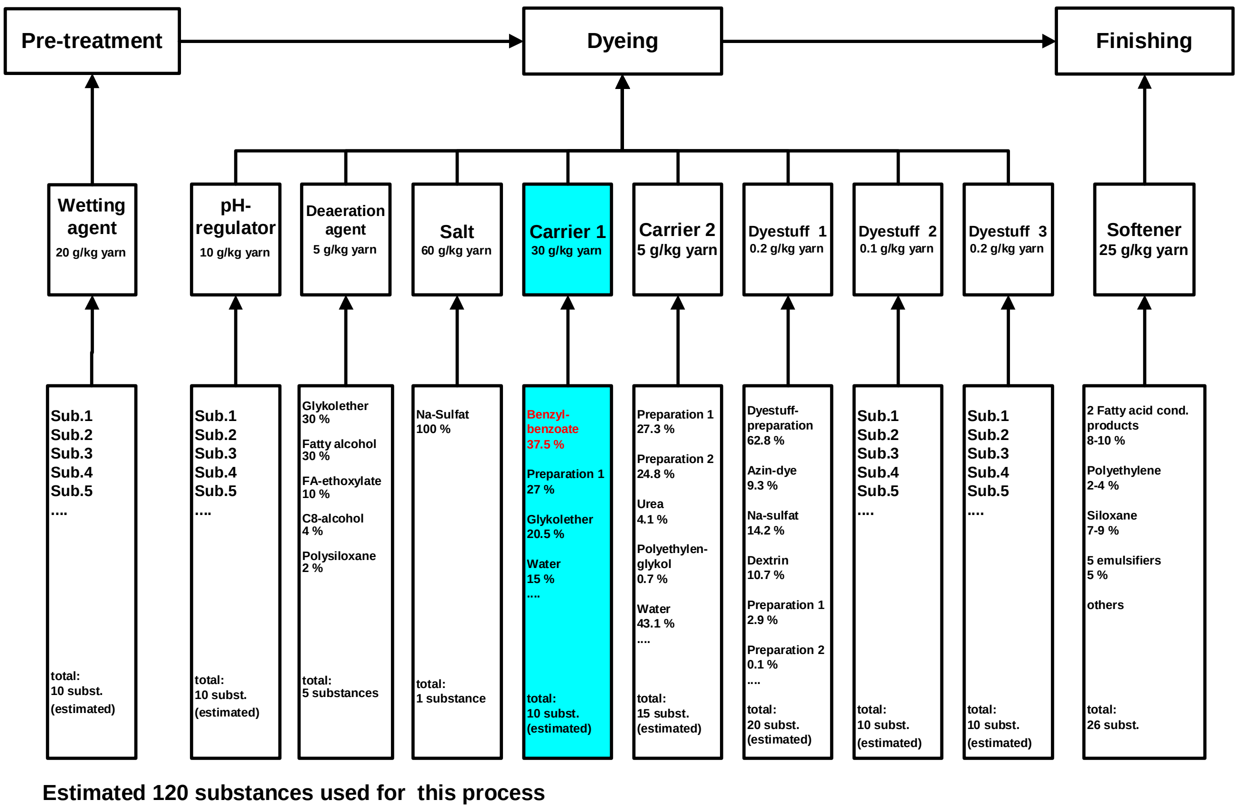

Figure 5.4: Finishing PES/PAN yarn

5.2.2 The textile supply chain containing the critical substances reactive dyestuffs black and brown

The identified reactive dyes supply chain ends with finishing of CO yarn. This includes the same non EU textile chemicals and dyes supplier and French yarn finisher as under 5.2.1. It is also part of the value chain shown from a general perspective depicted in Figure 5.3.

Figure 5.5 shows the full process details and the position of the selected critical substances of interest (by accident two reactive dyestuffs, **reactive dye black and brown could be identified** as components of this reactive dyestuffs formulation).

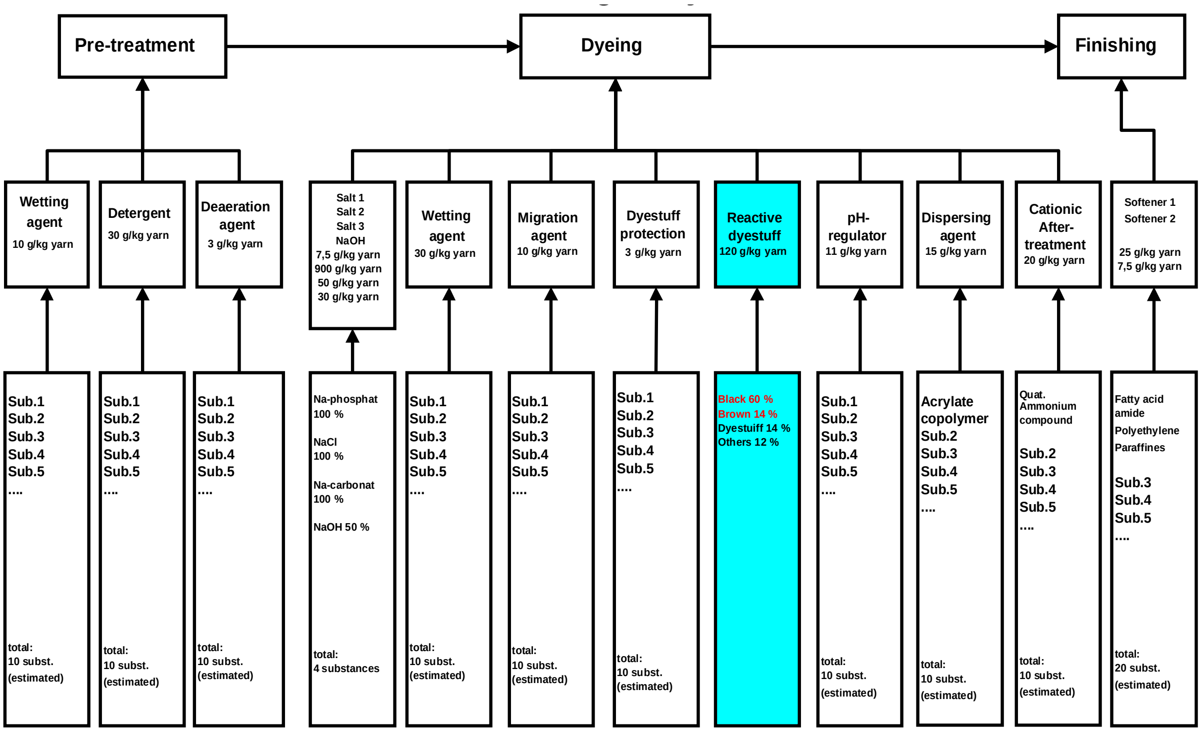

Figure 5.5: Finishing CO yarn

5.2.3 The textile supply chain containing the critical substance fatty acid condensation product B (FACB)

The identified FACB supply chain ends with finishing of cotton/polyester yarn. This includes a medium German textile chemicals supplier and a Spanish yarn and fabric finisher. Figure 5.6 shows the full process details and the position of the selected critical substance of interest (**fatty acid condensation product B** as component of a softener).

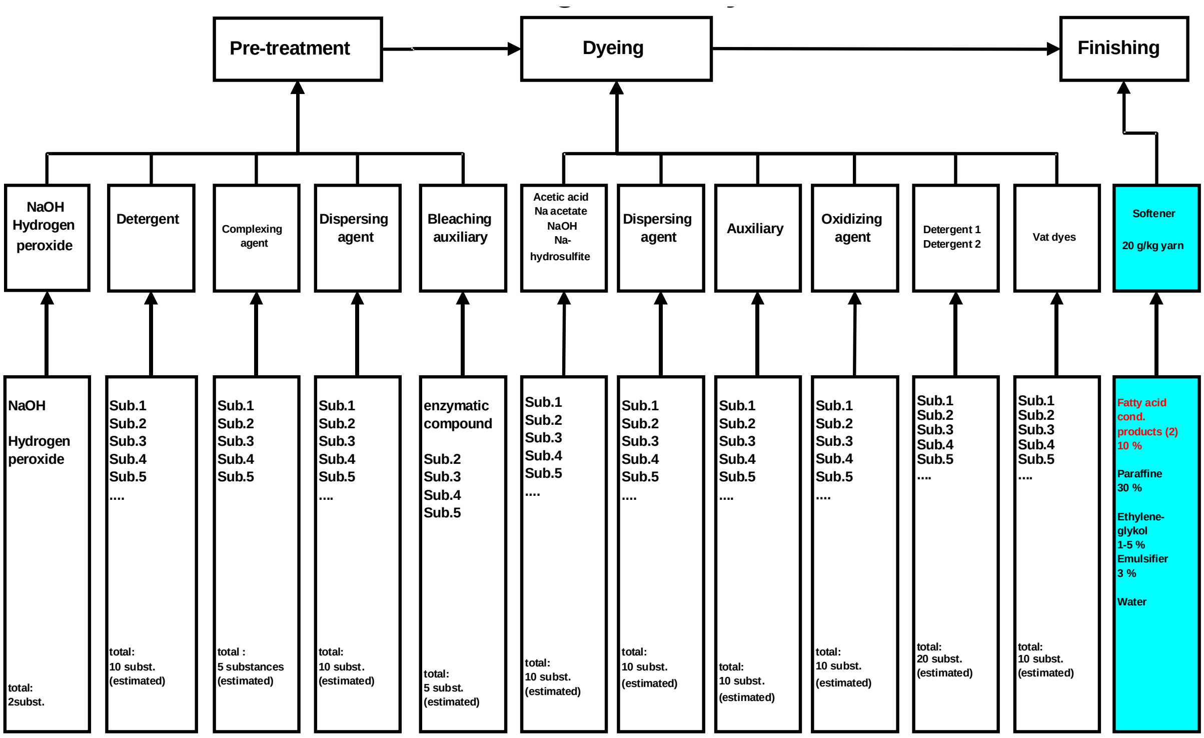

Figure 5.6: Finishing PES/CO yarn

5.2.4 The textile supply chain with the critical substance fatty acid condensation product A (FACA)

The identified FACA supply chain ends with finishing of cotton fabrics. This includes a German medium textile chemicals supplier and a BeNeLux fabric finisher. Figure 5.7 shows the full process details and the position of the selected critical substance of interest (**fatty acid condensation product A** as component of a softener).

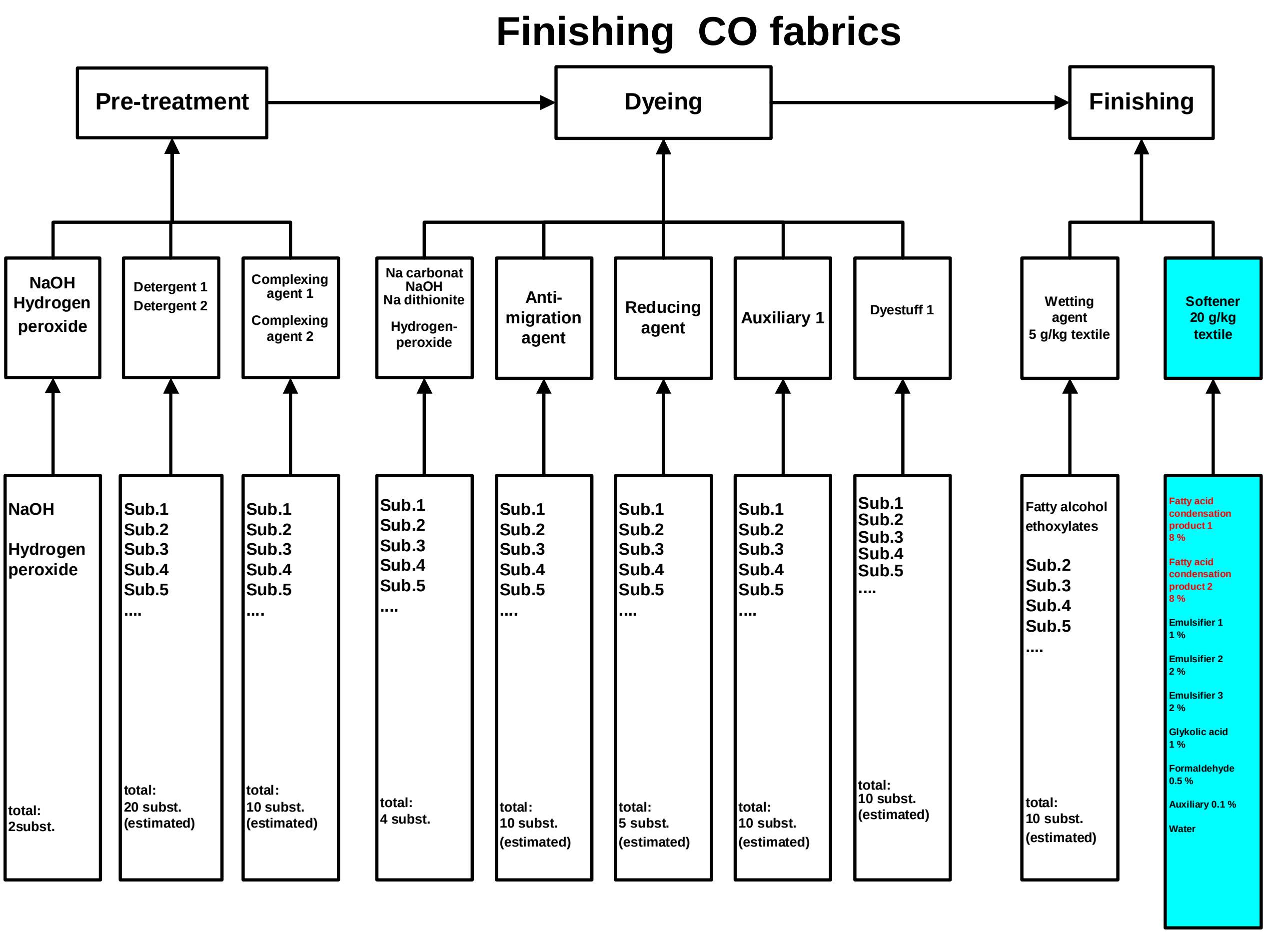

Figure 5.7: Finishing CO fabrics

5.2.5 The textile supply chain with the critical substance melamine resin

The identified melamine resin supply chain ends with finishing of polyester/cotton fabric. This includes a German medium textile chemicals supplier and a BeNeLux fabric finisher.

Figure 5.8 shows the full process details and the position of the selected critical substance of interest (**melamine resin** as component of a cross-linker).

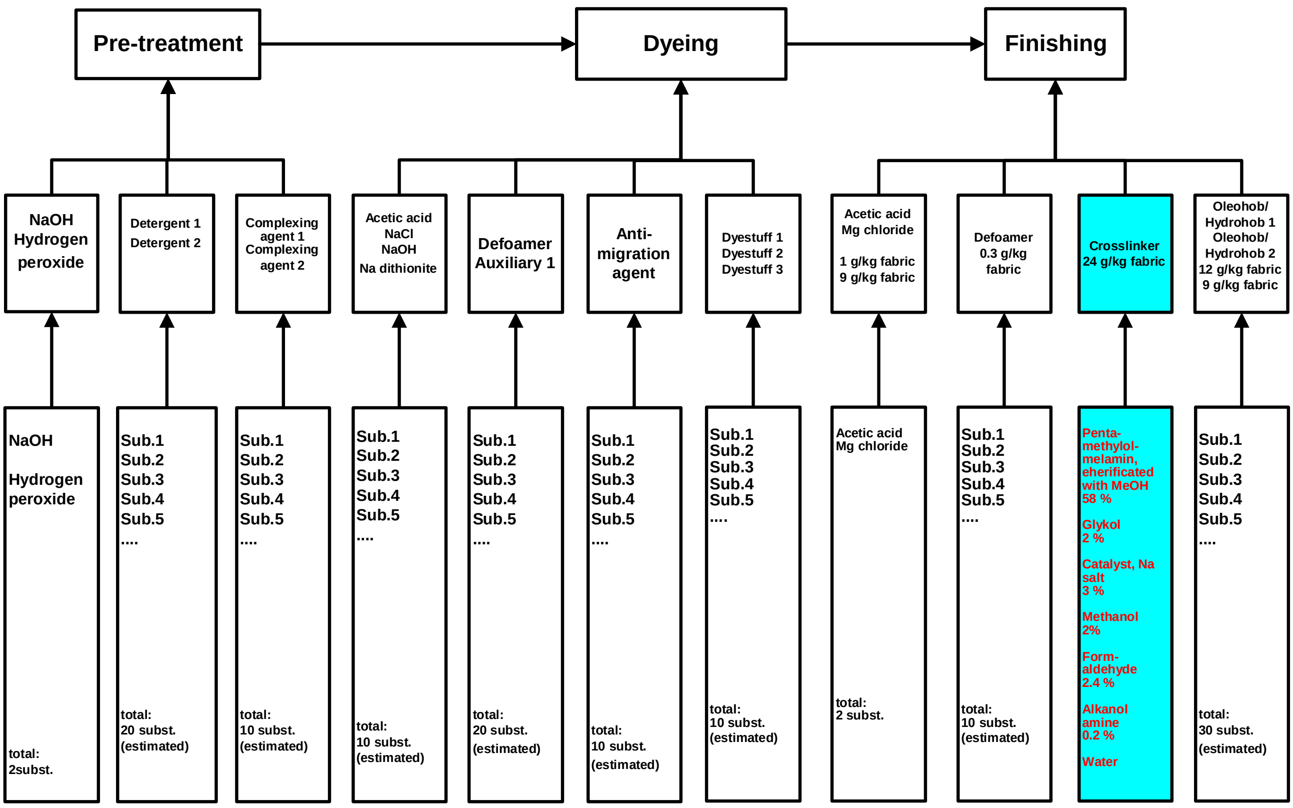

Figure 5.8: Finishing PES/CO fabric

6 Economic analysis: Vulnerability assessments and cost pass-through

6.1 Introduction

This chapter discusses the main results of the economic calculations and analysis which have been conducted for 6 substances of critical importance for textile finishers out of the basket of 4 major substance groups.

Substance	Substance group	Current volume
Fatty acid condensation product A	Softeners	30 t/y
Fatty acid condensation product B	Softeners	50 t/y
Melamine resin	Easy care products	200 t/y
Benzylbenzoate	Dyeing carriers	250 t/y
Reactive Dyestuff “Brown”	Cotton dyestuffs	85 t/y
Reactive Dyestuff “Black”	Cotton dyestuffs	>1000 t/y

The applied methodology is similar to the methodologies from the two studies carried out under the umbrella of the Memorandum of Understanding between the UNICE, CEFIC and the Commission (respectively the KPMG study commissioned by the industry associations and the study of the Commission service IPTS).

As reported in the previous chapter, the inputs for this quantitative analysis of the six critical substances within five real life supply chains have been based on interviews with three textile chemical suppliers among which one reputed non-EU textile chemicals supplier, and with three textiles finishing firms, all based in the EU. The interviews have established that the interviewed chemical suppliers actually sell one or more of the critical substances under review to at least one of the textile finishing companies.

However, as one more textile chemicals supplier and six more textiles finishers were also interviewed, the total number of participators has been thirteen companies. The interviewed companies are located in Germany, Italy, France, Portugal, Spain, the BeNeLux, a New Member State and a Non EU country. All interviews have been conducted with the same questionnaires, included in this report as Annex 5 and Annex 6 (for chemical suppliers and textile finishers respectively). The questionnaires have been based on those used in the IPTS study; changes have been made to take better account of the particular situation of textile chemical supply chains.

It should be pointed out that a large part of the collected data is confidential because it concerns sensitive business information on costs, prices and margins of individual substances and on technological know-how. Due to the confidential nature of these data, it has been agreed with the participating companies that the company names, brand names, exact descriptions of the investigated individual substances and supply chains will not be publicly reported.

The structure of this chapter is as follows. Section 6.2 explains in more detail the methodology: the concepts of "vulnerability" and of a full cost pass-through price increase, with a discussion of the formulas used and the required inputs and assumptions. The next three sections present the results of the vulnerability calculations: section 6.3 the results of the baseline simulation; section 6.4 the results of the sensitivity analysis; section 6.5 explores the effect on vulnerability outcomes when varying the production volume. Section 6.6 presents the results of the cost pass-through analysis, namely the NPV calculations and a rough assessment of the cost pass with the indication of the relevant price elasticity. The last section explains the relation with the business case results presented in Chapter 7.

6.2 The methodology of the quantitative analysis: NPV and cost pass-through

6.2.1 Introduction

This study aims to investigate the real-life supply chains of single critical substances, just as has been the case for the KPMG and IPTS studies. IPTS has documented their methodology which has been extensively discussed in the REACH Impact Assessment Working Group; the part on the quantitative method (Annex A, p. 36 of this methodology document [7]) has been followed closely with some minor adaptations according to the specific aspects of the textile and textile chemicals industry (see Annex 4). The IPTS methodology also includes questionnaires for the interviews with the chemical suppliers, formulators and their downstream users. The modified versions considering the special needs of the textile chemicals supply chains are provided in Annex 5 and 6. The most noteworthy change is the integration of the chemical supplier and formulator questionnaires related to the fact that textile chemical suppliers mostly sell their self-made critical substances in the form of a "package" preparation (see Chapter 3).

The methodology presents two main criteria to assess the impact of REACH in the context of a particular supply chain:

- The "*vulnerability*" of a particular (critical) substance for withdrawal of the market for commercial reasons due to the registration costs and testing costs of REACH;
- The "*pass-through*", along the supply chain, of the direct and indirect costs associated with the registration and testing requirements of Reach.

In the next three sub-sections, the main elements of the methodology related to these two criteria are explained. Section 6.2.2 presents the relation between vulnerability and the so-called NPV criterion. Section 6.2.3 provides the required details of the NPV analysis, in particular the required quantitative inputs and the corresponding assumptions. The last sub-section briefly discusses the calculation method of the price increase required to fully pass on the registration and testing costs to the customers.

6.2.2 The NPV criterion: Vulnerability for commercial withdrawal

The assessment whether a particular substance is "vulnerable" for withdrawal from the market by a manufacturer, is basically a comparison of the costs the manufacturer incurs with the registration under REACH of this substance (Registration Costs, RC), with the future flow of profits on the sales of this substance (Net Present Value, NPV). The basic idea is that when the additional REACH costs render further production not profitable anymore, the manufacturer may consider pulling the substance from the market.

The *NPV criterion* summarises this as:

NPV>RC	Not Vulnerable
NPV<RC	Vulnerable

This approach is widely applied in companies for investment decisions. Seen from this perspective, the NPV criterion considers the registration decision under REACH as an investment project that “allows” the substance to exist on the market and, therefore, to generate profits in the future. The name “NPV” takes into account that the comparison takes the different time periods of the costs and profits into account through the calculation of their so-called Net Present Value (NPV).

It is important to note that vulnerability does not imply an automatic withdrawal; other considerations may also play a role (strategic importance of substance, part of a sales package, part of an internally integrated raw material supply chain, substance is part of a certified process et cetera) , hence the term “vulnerability”.

6.2.3 The NPV formulas for vulnerability and full cost pass-through price increases

The NPV formula[3] used for the ***vulnerability calculations*** is:

$$NPV_T = \sum_{t=1}^{T} \frac{P.A - C}{(1+d)^t} - RC_0 = \frac{w.P.A}{f_T} - RC_0$$

As can be seen from the formula, the following inputs are required for the NPV calculation:

- The annual production / sales volume of the substance (***A***);
- The sale prices of the substance (***P***);
- The cash flow of the substance (net profit and amortization), reflected in the (gross) margin ***w*** = (P.A – C) / P.A (with C the production costs);
- The number of years taken into account (***t*** = 0, 1, …, ***T***);
- The discount rate (***d***) which corresponds with the annuity factor (f_T);
- The registration and testing cost of the substance (***RC***), as determined by its annual production volume vis-à-vis the volume band of the phase-in period.

[3] The formula comes straight from Annex A, p38 of the IPTS methodology document [7]. Note that the meaning of the term ***NPV*** is different from that presented in the previous section. Here, the vulnerability criterion is NPV<0, as the registration costs are now included in the NPV term.

The set-up of the NPV calculation as described above also provides an opportunity to calculate the ***price increase*** in case the supplier of the critical substance is able ***to fully pass on the costs of registration and testing***. This means that the addition to the sales price must have a present value equal to the registration and testing costs. The formula above can thus be rewritten so as to calculate the new price required to earn back the registration and testing costs in the required period and so keeping the profit flow of the substance unchanged. The used formula is:

$$p \equiv \frac{dP}{P} = \frac{RC_0 \, f_T}{A} \cdot \frac{1}{P}$$

where ***p*** stands for the percentage sales price change and ***dP*** for the absolute change in the sales price.

6.2.4 The NPV analysis: the inputs and assumptions

This sub-section discusses the derivation of the inputs of both formulas out of the interview material in the same order as the list above. It reveals that only the first item from the list above, namely the production volume, has been directly derived from the interviews. The other inputs required in varying degree estimations or assumptions. As much as possible, the consultants used those applied in the IPTS methodology document [7].

In the next chapter, some of the issues underlying these inputs will be discussed in more detail, highlighting, where possible, the (wider) context of the six critical substances and the supplying companies, as made clear in the business case interviews. Some of these aspects will be mentioned here as well but the focus of attention remains on the nature of the inputs.

The annual production volumes and constancy assumptions

The interviewed companies which were suppliers in the identified real-life supply chains of the critical substances were able to provide directly the production or sales volumes for the year 2004. The difference between sales and production was said to be insignificant. The volumes have already been mentioned at the very start of the chapter. The volumes concern the substances, not the "packages" in which they are sold.

Unavoidably, the 2004 production volume data are used for all the years of the period considered in the NPV. In fact, for many inputs, the formula implicitly relies on the following *constancy assumptions*:

- Constant production / sales
- Constant substances prices all along the years of the payback period
- No change in the working capital
- No investment for the chemical textile business unit
- Stable taxation

These constancy assumptions take no notice of the current downward trends of the European textile chemicals industry (such as decreasing prices and sale volumes, and downward pressure on gross margins). Arguably, these assumptions can therefore be regarded as "conservative" because taking account in the formula of falling volumes, prices and margins would lead to lower NPVs, and consequently to more indications of vulnerability in a given sample of substances. However, in order to avoid arbitrary assumptions as to what extent the current downward trends are relevant for the future time of the registration, we have preferred using only the most recent available production data.

The virtual sales price of a critical substance

T*he sales pricse of the critical substances* were not readily available; they had to be calculated with the business data collected in the interviews. The reason is that, in most cases, the critical substances are sold as a (key) ingredient of a marketed "package", a preparation manufactured by the manufacturer himself. As a consequence, the interviewed textile chemical suppliers do not work with sales prices and (gross) margins for the critical substances, but with those for the "packages" in which they are sold.

Based on the cost prices and concentration shares of the ingredients in the "package" made available by the suppliers, a "*virtual sales price*" of the critical substance has been calculated:

a share of the total gross margin of the “package” has been added to the cost price of the critical substance. The share is the proportion of the critical substance in the “package” as measured in weight percentages, with a correction for water which is assumed to bear no costs and no margin. In other words, the margin of the preparation is attributed to the ingredients of the “package” with exception of the solvent “water” along the relative concentration percentages in the package.

The formula for the “substance price” calculation is as follows:

$$P_{crit} = \frac{C_{crit}}{A_{crit}} + \frac{Conc_{crit}}{1 - Conc_{solvent}} \cdot a \cdot \frac{w_{package}}{Conc_{crit}}$$

where:

- The subscripts “***package***”, “***crit***” and “***solvent***” are indications that the variable concerns the marketed “package” preparation, the critical substance ingredient (i.e. the one under review) or the solvent of the preparation (here always water) respectively;
- “***Conc***” stands for “concentration”, namely the weight percentage within the preparation;
- Just as before, ***P***, ***C***, and ***A*** stand for sales price, production costs and volume respectively; as a consequence ***C/A*** stands for the cost price;
- Also as before, ***w*** stands for (gross) margin, measured in Euro per kilogram; in the formula, $w_{package}$ is divided by $Conc_{crit}$ in order to transform the margin form kilograms preparation to kilograms of the critical substance.
- a stands for the rate in which the (gross) margin of the preparation is attributed to its ingredients (save the solvent water); unless indicated otherwise, a =1.

Estimation of the cash flow of a critical substance

For reasons of exposition, the discussions above have assumed that the data for the sales price and gross margin of the marketed “package” are available. For a number of the selected critical substances, however, the actual situation is somewhat more complicated. Instead of one uniform sales price, in these cases there is a range of sales prices which depends on varying service conditions. Calculating an “average gross margin” would require the use of much more sensitive and confidential market information than the companies were willing or allowed to hand over. Moreover, it would also involve an estimation of the costs of the various services provided to the customers of the “package”.

Consequently, in these cases, it was decided to approximate the gross margin through an estimation of *the cash flow of the single critical substance*.. However, companies do not calculate a “net profit” for an individual substance, as that would require the attribution of the overhead costs to the various substances. For assessing the “profitability” of a substance, they use measures such as value added (cost price minus the cost of all material inputs) or the gross margin (sales price minus the variable costs). Therefore, the consultant team choose to adopt the “net profit” of the relevant company business unit as the best possible net profit measure of the individual substances of that business unit. In order to obtain the substance cash flow, the average depreciation & amortization percentage was added to this net profit measure.

REACH registration and testing costs

Two different scenarios about the size of the REACH registration and testing cost have been used in the calculations. They are the ECB cost scenarios “average testing needs” and “maximum testing needs” which have been developed in the context of European Commission Extended Impact Assessment[4] and explained in detail in the background document [12]. The table below presents for both scenarios the registration and testing costs for the distinct volume bands; they consist of the Agency registration fee, the administrative costs for firms and the testing costs:

Volume band	Average testing needs	Maximum testing needs
1-10 t/y	12 400	13 500
10-100 t/y	89 000	168 000
100-1000 t/y	207 900	288 600
>1000 t/y	265 900	335 700

[4] Only the former is just in the Extended Impact Assessment of the Commission’s 2003 proposal [2]. Both scenario’s have been used in the business cases of the KPMG study [5]

(t/y = tonne per year; the presented figures are in Euro and rounded)

It is important to note that the cost figures are *averages* of the actual registration and testing costs expected to occur in the various volume bands. The actual testing costs depend on the availability of test data; the applicability of QSARs and other alternatives to testing; and the possibilities to waive the test. Consequently, the averages in the table reflect the (assumed) general situation for these factors in the various volume bands.

This poses the question as to whether the assumptions on which the average cost figures are built are relevant for the situation of textile chemicals in general and of the six specific critical substances. Based on the information on these substances collected in the company interviews[5] and on the survey information, one can say with some confidence that these assumptions are "conservative", meaning that they lead to cost figures likely to underestimate the costs incurred in the case of the 6 critical substances:

- From the interview results, it can be inferred that the *availability of test data*[6] is less than the assumed average in the cost scenarios. For sure, companies indicated that for none of the substances they had a complete dataset. For most of them, only basic test data are available[7]; for the reactive dyestuff "black", IUCLID provides an old data set which is not validated.

  More generally, often the available test data are not derived though GLP test procedures; moreover, a lot of test data used by the companies relate to the "package" preparations only. Also, in contrast to the scenarios' assumptions, the required set of physical-chemical data seems to be far from complete; as the critical substances are not sold and used in their pure form, but only in "packages" and "recipes", companies can do without the largest part of these data.

- The interviewed textile chemicals suppliers are less optimistic about the possibilities of *consortium formation* than assumed in the cost scenarios. These scenarios assume that the

[5] Including a number of follow-up interviews.

[6] Reporting the precise content of the (likely) available test data for the 6 substances is not possible under the confidentiality arrangements with the interviewed companies. However, the statement in the main text is based on their endpoint specific replies to question X from the questionnaire. The consultants have complemented the interview results with checks in their chemicals databases including comparisons with similar substances.

[7] Specifically, acute oral toxicity; eye and skin irritation; bacteria toxicity; to a certain degree also fish toxicity and some biodegradation data.

REACH data sharing arrangements will prevent duplication of (new) tests though separate registrations will occur. In some cases, the companies think that they are the sole supplier of the critical substance. In the other cases, they see the varying of technical grade and of impurities in the substance as a considerable barrier to effective consortium forming. The interviewed companies are not eager to share information on these aspects of their substance as this concerns sensitive business information; they also wonder about the validity and use value of competitors' test information, for the same technical reasons. In some cases, they are not aware of another supplier with which they could form a consortium.

- As argued in section 3.2.1, for textile chemicals t*he applicability of QSARs* and other alternatives to testing seem to be much lower than is on average the case, due to varying technical grade and impurities. Indeed, the interviewed textile chemicals suppliers are sceptical about the prospects of QSAR-application for their products.

The interviewed companies themselves have all said that they expect to incur higher registration and testing costs than the costs mentioned in the ECB scenarios, particularly the scenario "average testing needs". Annex 8 discussed the issues in more detail for two of the critical substances, namely melamine resin and benzylbenzoate.

The discount rate and the number of years

Finally, both the *discount rate* (of 7%) and the *number of years* (3) have been set by the consultants with a view to the current general economic situation. The fairness of these assumptions has been discussed with firms. The 7% discount rate is a "frequent" figure assumed when considering investment decisions; it considers both external inputs (interest rate) and internal financial returns objectives.

Based on the indications from the interviewed textile chemical suppliers, the consultants have chosen a pay back period of 3 years. This may appear "short" for an investment of this nature since the technical life of the registration, the "investment" in our case, is longer than three years. However, the companies are not prepared to consider a "registration" as an "investment". Indeed they perceive the Reach registration in a similar way as the usual registrations and certifications (ISO et al.) which are generally amortized in one year. Thus, they consider this kind of expenses as "costs" and not as "investments". A payback of three years is therefore a "compromise" between the habits of the companies for similar cases and the "investment approach" of the methodology. Note that the IPTS methodology document [7] reports payback periods of 3 to 5 years.

Since the selection of "fair" quantitative assumptions is always questionable, the consultants decided to analyse more than one simulation, by varying the value of different inputs, in order to check the robustness of the vulnerability results found in the basic simulation discussed so far. In sections 6.4 and 6.5 the outcomes of this "Sensitivity Analysis" will presented in some detail.

6.3 The results of the NPV analysis: vulnerability in the baseline simulation

The base simulation concerns the NPV calculations which, as mentioned in the previous section, has used as inputs a discount rate of 7%, a substance cash flow percentage of 8% and a 3 year period, together with the 2004 production volumes and where required the construct of "virtual substance sale price". The NPV has been calculated twice, for the registration and testing costs of the scenarios "average testing needs" and "maximum testing needs".

The results of this simulation for the six substances[8] are that:

- The high volume substance reactive dyestuff "Black" is the only that is clearly *not vulnerable.*
- Three substances, , two low volume and one medium volume substance, are to be considered robustly *vulnerable* (thus irrespective of the costs scenario):
  - Fatty acid condensation product "A"
  - Fatty acid condensation product "B"
  - Melamine resin

[8] See Annex 10 for a more detailed presentation of results.

- The two remaining substances may be alternatively *vulnerable or not vulnerable* depending on the registration and testing costs based upon the "average QSAR" and "minimum QSAR" testing cost scenarios respectively:
    - Reactive dyestuff "Brown"
    - Benzylbenzoate.

Annex 9[9] provides a example with numbers how methodology has been applied to arrive at the conclusions such as above.

6.4 Sensitivity analysis of the vulnerability calculations

As already indicated above, through a change in the REACH costs, the outcomes of the NPV calculations change if the inputs vary (part of which depend on assumptions). That's why several more calculations have been done with different assumptions and input values than those in the basic simulation presented above. For the purpose of this sensitivity analysis, a simulation system has been set up in which the basic inputs can be easily changed.

The sensitivity analysis presented here concerns a variation in respectively:

- The number of years considered: 7 years instead of 3;
- The calculation of the "virtual sales price" for the critical substance: instead of attributing 100 % of the gross margins on the "package" to the ingredients except the solvent water, only a 50% attribution of this gross margin, with the other 50% remaining on the "package"; this variation addresses the issue of vertical integration
- A higher cash flow percentage of 12% instead of 8% for the sample, which reflects the view of the companies that the critical substances contribute more than average to the profit targets set for the whole portfolio; this addresses the method used for attributing

[9] All quantitative inputs presented in this Annex are drawn from the actual cases of the study (companies interviewed), however, data have been slightly changed in order to warrant that neither substance nor commercial preparation nor company can be identified. The Annex is meant as a mere example to make clear the applied methodological approach. All supplied figures in italics are inputs provided by the companies. The "registration cost" of the substance refers to QSAR standard costs

part of the gross margin of the "package" preparation to the critical substance under review in the "package".

- The combination of the three variations mentioned above;
- (In the next section) changes in the production volume with special attention to the effect of the volume thresholds, where the REACH registration and testing costs change as well.

The other inputs remain unchanged on their value in the basic calculations when the above mentioned inputs are varied. Specifically, the registration and testing costs are set in accordance with the "maximum testing needs" scenario.

As regards the rise in the number of years from three to seven, the outcomes do not change. The Reactive dyestuff "Black", reactive dyestuff "Brown" and benzylbenzoate remain non vulnerable; fatty acid condensation products "A" and "B" and melamine resin remain vulnerable. The only difference is that reactive dyestuff "Brown" and benzylbenzoate now remain non-vulnerable if the higher registration and testing costs of the scenario "minimum QSARs" are used.

As regards the calculation of "virtual sales price" for the substance, when half of the gross margin of the package remains undivided between the ingredients, the only change as compared to the basic calculations is that benzylbenzoate is found to be vulnerable regardless of the variation in the cost scenarios. The outcome for reactive dyestuff "Brown" still depends on the cost scenario used, as in the basic calculations. Also, the previously non vulnerable "reactive dyestuff black" remains non vulnerable, and the previously vulnerable substances (fatty acid condensation "A", fatty acid condensation "B" and melamine resin) remain vulnerable.

When the cash flow percentage is 12% instead of 8%, the outcomes do not change. The reactive dyestuff "Black", reactive dyestuff "Brown" and benzylbenzoate remain non vulnerable; fatty acid condensation products "A" and "B" and melamine resin remain vulnerable. The only difference is that benzylbenzoate now remains non vulnerable if the higher registration and testing costs of the scenario "minimum QSAR" are used.

With the three variations combined, the Reactive dyestuff "Black", reactive dyestuff "Brown" and benzylbenzoate remain non vulnerable, the latter two now also for the higher costs of the scenario "minimum QSAR". Somewhat surprisingly, fatty acid condensation product "A" becomes non vulnerable in the scenario "average QSAR" only. Fatty acid condensation product "B" and melamine resin remain robustly vulnerable.

To summarize the sensitivity analysis results, with the variations in the inputs to the NPV calculations described above:

Substance	Tonnage band	Indication of withdrawal risk
7. Fatty acid condensation product A	10 - 100 t/y	Vulnerable
8. Fatty acid condensation product B	10 - 100 t/y	Vulnerable
9. Melamine resin	100 -1000 t/y	Vulnerable
10. Benzylbenzoate	100 -1000 t/y	Vulnerable in some scenarios
11. Reactive Dyestuff "Brown"	10 - 100 t/y	Vulnerable in some scenarios
12. Reactive Dyestuff "Black"	>1000 t/y	Not-vulnerable

In other words:

- The high volume substance reactive dyestuff "Black" is robustly non vulnerable;
- The low volume substances fatty acid condensation "A" and "B" and the medium volume substance melamine resin are robustly vulnerable (only in one instance, the first substance was found to be non vulnerable);
- The low volume substance reactive dyestuff "Brown" and the medium volume benzylbenzoate are vulnerable or non vulnerable depending on the choice of the inputs to the NPV calculation. Particularly, the assumptions on the cost scenario seem to be crucial on the outcome.

6.5 Vulnerability according to NPV and the changing of the production volume

The simulations above also demonstrate that the production volume plays a significant role for vulnerability. Based on several simulation runs, it appears that the four volume bands within the phase-in of registration may have unequal effects on the vulnerability of substances according to their quantities and the associated registration costs.

The Figure below illustrates the problem (without the pretension that the curve exactly reflects a range of simulation outcomes).

Generally speaking, when the production increases towards a threshold, the registration and testing costs get diluted over a larger volume, and, consequently, the vulnerability as expressed in the NPV value decreases. When the production volume crosses the threshold, the vulnerability sharply increases due to the additional registration and testing requirement costs. One could say that companies with a successful chemical are "punished" in a way for their growth when passing a volume threshold.

The situation with a declining production is not symmetrical to the one with a production increase. In fact, this case has not been depicted in the figure. When the production declines and approaches of a threshold from above, the vulnerability in terms of NPV value gradually increases. However, the crossing a threshold does not diminish the vulnerability, since the costs on the registration and testing requirements no longer needed in the lower volume category cannot be recouped.

It is understood that the level of the registration and testing costs is also an important parameter to consider. When the registration and testing costs rise in one or several volume bands, the overall incidence of vulnerability in these volume bands will increase (other things being equal).

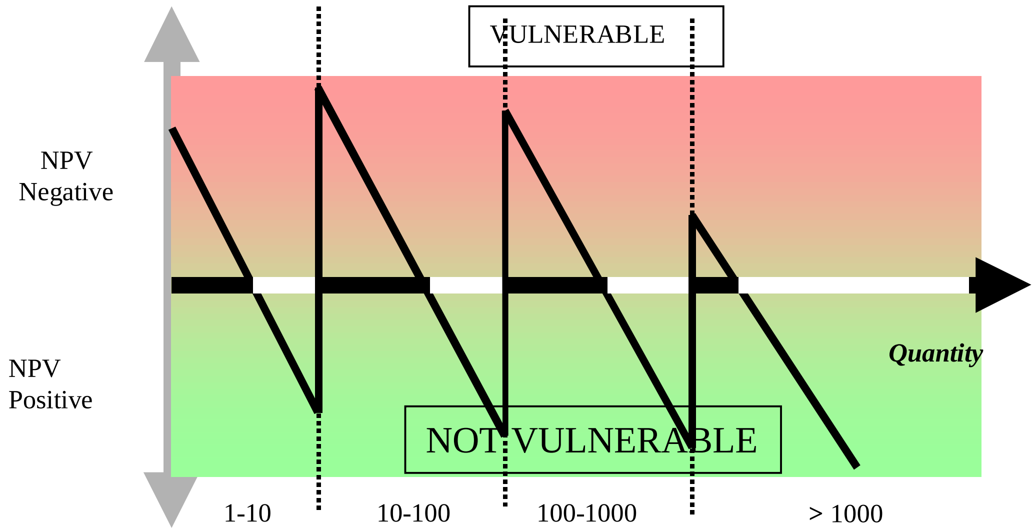

Figure 1.1: The variation in vulnerability with changes in production volume

6.6 The quantitative analysis of cost pass-through

This chapter first presents some calculation results on the prices increases required to pass on fully the REACH registration and testing costs, and subsequently discusses a rough quantitative comparison of volume and price trends on portfolio level which gives an indication of the prospects of cost pass-through for the textile finishing companies, to the textile sector and to the final consumer.

The price increases in case of a full cost pass-through: calculation results

The results presented here are *the full cost pass-through price increases related to the "package"* since these are the products marketed by the textiles chemicals suppliers. However, they indicate only the effect of the price increase of one ingredient in the "package", namely the critical substance under review. To this end, the full cost pass-through percentage price increase for the "virtual sales price" of the critical substance which has been calculated with the formula mentioned in section 6.2.3, has been multiplied with the weight share of the critical substance in the "package" without the solvent water.

From the above it follows directly that the "package" sale price increases are lower than the virtual substance sale price increases (the "*dilution effect*"), except when no dilution with a solvent (water) takes place. As indicated in earlier chapters, the considered "package" can also contain other critical substances which are also affected by REACH. .However, a full assessment of this "*culmination effect*" falls out of the scope of this study.

With a discount rate of 7%, a substance cash flow percentage of 8% and a 3 year period, as in the base case NPV calculations, the "package" price increases related to passing on fully the costs of the "average testing needs" scenario lie in the range of about 0.5 to 7 %. Melamine resin is the exception with a 24% price increase; as this substance is sold in its pure form, no price dilution is possible. The full cost pass-through "package" price increases related to the costs of the "maximum testing needs" scenario are of course higher, but the relative pattern remains roughly the same. The table bellows reports the found full cost pass-through prices for the "packages":

Substance	Full cost pass-through price increases for the "packages"	
	"average testing needs"	"maximum testing needs"
1. Fatty acid condensation product A	6 ¾	13 ¼
2. Fatty acid condensation product B	5 ½	11
3. Melamine resin	24	35 ¼
4. Benzylbenzoate	3 ½	5
5. Reactive Dyestuff "Brown"	¾	1 ¾
6. Reactive Dyestuff "Black"	½	¾

An analysis of the costs pass through possibilities with price and volume trends

The methodology of the IPTS paper [7] refers to the price elasticity as a measure of the potential of textile chemicals suppliers to pass on the REACH registration and testing costs to their customers. However, the suggested derivation of the price elasticity, on portfolio level and with volume and price indices, requires a considerable data gathering effort while it does not guarantee to arrive at a measure that adequately describes the company's capacity to change its price in order to pass on the costs[10]. That is why this section presents a somewhat rougher approach, namely through an inspection of price and volume trends.

The information collected during the interviews[11] with textile chemicals firms indicates that the trend movement of the sales prices was in general decreasing (with unit prices decreasing with up to 15%); only in a few cases (a clear minority) a stability of prices or even a moderate increase was observed. In the majority of the cases, the sales volumes also show a clear downward trend (from - 3% to -20% according to different companies) with one exception of a package that on the whole performed very well (+27%).

[10] As a price index of a portfolio has to use substances volumes as weights, and the corresponding volume index prices, it is difficult to disentangle volume and price effects, especially with rather short time series. In fact, the method cannot rule the calculated elasticity gets the wrong sign, not even for moderate changes in prices and volumes.

[11] This information has been collected with Table 7 and Table 8 of the Questionnaire for Downstream users (Annex 6).

On the other hand, since the year 2000 the costs prices of the textile chemicals have shown little change. (Effectively, that means a small fall in these costs prices in relative terms considering inflation.) It appears that the various changes in the prices of its production inputs (such as raw materials, chemicals, energy and others) have more or less cancelled each other out. The variation ranged from a decrease of 15% to an increase up to 29%. During this period, the consumption of production inputs has decreased with 10 to 15%, again with one exception.

These trends suggest to a demand curve on company level which currently has a "high price elasticity" (i.e. relative large variations in quantities determined by small variations in prices). This impression is reinforced by the general erosion of the gross margins on the marketed products through the combination of falling sales prices and more or less constant cost prices implies (as sketched above). As is known form economic theory, there is an inverse relationship between the size of the margin and the price elasticity.

The conclusion from these company data is that currently the ***textile chemicals market as a whole cannot be classified other than as a "weak" market***, not able to accept additional costs. This outcome matches with the findings with costs and prices data estimated at the sectoral level.

Further proof of the weak competitive situation of textile chemicals companies comes from a comparison of the *relative poor performance of the textile chemicals as compared to other chemicals* in the portfolio of the same chemical company. For instance, published data regarding the consolidated operating profit of a large, well known chemical company is 8.7 %. However, its textile chemicals unit only scores a meagre 4.7 % whilst the best perfoming unit peaks with a 16.0% profit rate.

The limited capacity of textile chemicals companies to pass on additional costs is not caused by a strong position of their customers, the textile finisher companies. On the contrary, their situation is similar in these aspects. Though a similar analysis as the one above for textile chemicals firms is not part of the study, the collected data and interview results all point to the current difficult situation for textile finishing companies. The ability of textile finishers to absorb (a part of) the passed on REACH costs, or to pass them on further down the textile supply chain seems rather limited. The strong competition in textile finishing has trimmed down profits. Moreover, the competitive pressures on the market for final (industrial) consumers implies that textile customers of the textile finishers are very reluctant to accept any price rise.

6.7 Concluding remarks: the relation with the interview results

The found vulnerability for textile chemicals, which appears to be concentrated on the lower volume substances, together with the limited possibilities for cost pass-through for textile chemicals suppliers and textile finishers, suggest that companies may consider the substitution possibilities of the (potential) vulnerable and consequently possibly deselected substances and of the substances which may become too expensive. A potential substitute must be "similar" in functionality but not vulnerable to commercial withdrawal (and of course also not a candidate for restrictions). The (costs) implications of substance substitution are not a part of the quantitative analysis. It will be considered in the next chapter on the business case outcomes.

It is important to stress again that the found vulnerability does not imply automatic withdrawal. The interviewed *textile chemicals suppliers* have indicated that they *wish to keep the "functionality" of their portfolio* in general and of their critical substances in particular on the market. They see this as an important element of their competitiveness.

This implies that as part of their preparations system strategy, they will try to reformulate some "packages" with similar substances which are already being produced in higher volumes. However, the possibilities of doing so may be limited due to the potentially high number of vulnerable substances occurring in the 1 to 100 tonnage band. Consequently, they have said that they cannot rule out a portfolio rationalisation which will be concentrated on low volume substances nor that a part of the production will be shifted to non-EU subsidiaries ("dual use"). As has been argued above and will be illustrated with some worked out cases in chapter 9, it may be more attractive to export certain textile chemicals for use outside textile production outside the EU and (re)-imported into the EU the grey textile or the intermediate textile articles with the effects brought on with these chemicals.

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7 The outcomes of the business cases: vulnerability, substitution and reformulation

The intention of this chapter is to present the outcomes of the business case interviews on the aspects of vulnerability to commercial withdrawal and the (costs) implications of substitution. This chapter is therefore a natural penchant for the quantitative analysis presented in the previous chapter. It concerns all the relevant elements to put the quantitative results into its specific context.

As already touched on at the end of the last chapter, the textile chemicals companies will consider on a portfolio level how to react to the REACH registration and testing costs. Any decisions of the withdrawal of vulnerable critical substances and other substances will be made with a view on the whole portfolio. Such decisions depends on more elements than the NPV analysis, such as the financial buffer of companies, the textile companies' possibilities for further passing on costs in case of textile chemicals price increases, the costs related to the substitution of substance at both textile chemicals and textile finishing level, as well as its environmental aspects. These aspects are subject of this chapter.

The next chapter deals with the wider implications of the REACH registration requirements as has come out of the business case interviews. The import aspects will be further looked at in a separate chapter (Chapter 9) as they concern the specific "substance in articles" arrangements of REACH.

7.1 The financial buffer capacity in textile chemicals supply chains

As already indicated in chapter 6, the NPV calculations treat the REACH registration requirements as an investment project. The textile chemicals firms have indicated however that they face financial constraints that are not taken (fully) into account in such an approach:

- According to accountancy standards, the REACH registration costs need to be booked off in one year as compared to be "regular" investments.

- Due to the current difficult business situation, the access to financial means is rather limited: this applies both to external sources (bank loans, access to capital market) and internal sources (profit retention, cross subsidisation by other divisions). As mentioned in chapter 6, the returns to textile chemicals have lately been below the average of the overall return to chemicals manufacturing.

It is worth underlining that it was the companies themselves that pointed to problems of finance constraints. No part of the questionnaire addressed the “financial impact” of Reach. Both the interviewed textiles chemicals and the interviewed textile companies have expressed their serious concerns about this additional impact REACH could have on the already rather weak financial position of the companies. Their concern was in particular on the culmination of various costs: in case of the chemical companies, the culmination of registration costs at a certain point of time (also those passed on by their suppliers of chemicals used in the synthesis of textile chemicals); in case of both textile chemicals suppliers and textile finishers the costs of re-formulation and refreshment of recipes in the case of the textile companies. Textile finishers companies also pointed to the profit erosion related to the recent continuing downward pressure on textile prices and many of the SMEs among them on the financing constraints related to their relative small size.

7.2 The cost pass through possibilities of textile finishing companies

The potential of the textile finishing firms and their textile customers further downstream to pass on REACH costs was not an element of the IPTS methodology, which served as basis of the quantitative analysis of the last chapter. However, data on the cost shares inputs of textile companies coming from the business interviews give some indication of their possibilities. Chemicals account only for 3 to 5% of the total costs of an integrated textile company; consequently, even a significant increase of costs due to Reach, should have not more than a low weighted impact on the total production cost. This should make possible to pass on (part of) the additional costs to companies further down the textile value chain.

The same conclusion does not apply to the textile finishing phase of production and consequently to textile finishing companies. There, the relative costs of textile chemicals are much higher: chemicals account for 15 to 35% of the total costs. According to the sample of companies interviewed, the large majority (about 60%) have costs for chemicals around 15%

of total costs, whereas integrated textile companies (spinners and weavers) have costs sharers for chemicals between 2,5% and 6%; specialized finishers and dyers on commission have cost shares exceeding the 25% (up to 39%). In this sense, textile finishing is the chemicals "bottleneck" of the textile industry: cost increase in textile chemicals tend to weigh on this specific part of textile production

The high cost share for chemicals has to do with the competitive advantage related to the innovative and knowledge-intensive use of textile chemicals which is meant to serve as a "counterweight" to the fierce price competition from outside the EU, especially from the Far East. In fact, a further discussed in Chapter 8, the finishing (together with the design and the distribution systems) is the phase of textile production where the European textile industry still maintains a strong competitive position worldwide.

7.2.1 Substitution and withdrawal: specific considerations for the 6 critical substances and their sales formulations

In particular for the selected critical substances of this study the situation for possible substitution/withdrawal is as follows:

Table 7.1 will give an overlook about the 6 substances situation regarding some typical evaluation criteria

Substance	number of suppliers	sales form	technical grade	number of packages	kind of use
Melamine resin	1	pure	high	1	various
FACA	1	package	high	up to 25	various
FACB	1	package	high	up to 25	various
Benzylbenzoate	1-5	package	low	up to 5	specific
Reactive Black	1-5	package	low	up to 100	specific
Reactive Brown	1	package	high	up to 50	specific

FACA/B: Fatty acid condensation product A and B

The *melamine resin* represents indeed just *one special type* out of the huge sub-group of easy care resins and cross-linkers. But due to the fact that this special type is part of very complex finishing recipes a substitution with a similar type. On the other hand the NPV result indicates clearly vulnerability. This means that the supplier of the melamine resin may withdraw it and offer no substitute for the European textile downstream user. For them there is currently only a very small chance to find an alternative due to the unique position of this resin on the market which may lead to costly re-engineering of their production processes.

The *fatty acid condensation products A and B* represent just two types out of the wide basket of similarly chemically based softening substances. Their production follows the same physical-chemical rules and they address the same basic textile production need, so the NPV outcomes for all these alternatives are likely not to differ that much (the NPV clearly indicates vulnerability for the two selected ones). Therefore, quite a few low volume alternatives could no longer stay available, in case a portfolio rationalisation is pursued. As a consequence, the producers regard also in this case the withdrawal of many of these fatty acid condensation products as probable. However, there might be some chances for the textile downstream users to find alternatives on a high volume substance basis for this kind of softener types.

The *benzylbenzoate* is a special case. Due to the existence of a few suppliers there is at least a principal possibility for a consortium formation with possible positive consequences for the NPV result. But as it is shown in detail in Annex 8 (see also section 7.4) there is only a minor real chance due to technical grade issues. The interview partner for this case regards the probability as high to withdraw benzylbenzoate based packages form Europe without offering an alternative.

The two *reactive dyestuffs black and brown* point out another challenge similar to the melamine resin example. In the case study both dyestuffs are used in the same dyestuff "package" together with some other dyestuffs and chemical components. Undoubtedly the reactive black type is not vulnerable due to its high sales volume. However, depending on the NPV analysis assumptions the "colour shading" component reactive brown might be vulnerable. It is more than obvious that this special brown component is essential for the quality (special black with a touch of brown) of the sales package and cannot just be substituted. And even if the supplier would try this, the real challenge would be to introduce this new alternative to up to 500 textile finishing companies in the EU using this dye in thousands of dyeing recipes. The supplier of this dyestuff at the moment has no clear idea how to handle this conflict because he has to regard as well the potential influence of all the other components in this package. Therefore a forecast about his possible behaviour is impossible.

Whatever the decision of the suppliers involved in the upper cases will be as for substitution, reformulation, withdrawal et cetera it is needed to get a clearer idea about the possible reformulation efforts and costs in the case of substitution. The related situation shall be shown in the following chapter 7.3.

7.3 The cost implications of reformulation and re-engineering

In this section the foreseeable efforts for reformulation at both the chemical suppliers and textile finishers shall be outlined compared to the situation of today without REACH influence.

Reformulation efforts for textile chemicals suppliers

On the basis of the collected information, the *typical reformulation efforts* are estimated to be:

- Per preparation
  - Costs 5 000 – 50 000 Euro
  - Time 1 – 9 months
- For developing a new product
  - Costs 5 000 – 100 000 Euro
  - Time 1 – 9 months

For the chemical supplier, the option of reformulation may be only interesting if it is likely to be less costly than registering and testing the critical substance up for substitution in the reformulation effort.

Typical substitution rates for substances and preparations from a textile chemicals producer´s perspective over the last years based on the existing substance/preparation portfolio according to the interviews were

Withdrawal of substances by the substance supplier	1-10% of substance set
Recommendation of appropriate substance alternatives	nearly all of them
Withdrawal of preparations	5-10% of preparation set
New preparations for the market	3-7% of preparation set

Major reasons for withdrawal of substances and preparations were changes in legal requirements, phase out of raw materials, complexity reduction of portfolio and replacement through a new innovative product. Obviously the number of preparations is already today decreasing for the textile finishing market.

Reformulation efforts for textile finishers

The textile finishers however will be faced in either case with the necessity to reformulate his current recipes (part of which is unique to his firm) or even to completely redesign his production processes. On the basis of the collected information, *the reformulation process is estimated to cost the typical textile finisher*:

- For a recipe refreshment:
  - Costs 1 000 – 75 000 Euro
  - Time 1 – 3 months
- For Recipe and Process reformulation
  - Costs 10 000 – 300 000 Euro
  - Time 1 – 18 months

Given the number of reformulations, this may run into hundreds of recipes per preparation. The number of required refreshments and reformulations, combined with the costs per case, strongly suggest that they will put a considerable strain on the supply chains, apparently significantly more than the absorption or the pass-through of the costs of the REACH registration. Which one of the reaction strategies is to be preferred, seems to differ on a case-by-case basis.

Textile finishers indicated in the interviews that the annual withdrawal rate for preparations through the textile auxiliary supplier is in range of 1 -10. For about 50% of these alternatives are offered. The major efforts at the moment within textile finishing companies regarding their reformulation activities are associated to the “small recipe changes” mainly concerning the dyeing recipes. These changes go into the hundreds or even thousands per year and keep busy the established development departments of these companies. These minor “recipe refreshenings” are mostly driven by needed colour shade changings. Fundamental changes with associated costs and time efforts as shown in the table above are by far not so common and as much as possible avoided, except the customer asks for. This situation gives a certain idea what significant influence REACH might have to the textile finishers when assuming that a high number of special effect preparations (auxiliaries and dyestuffs) are going to be changed at about the same time.

7.4 Time to market considerations of withdrawal and substitution

So far, *time-to-market considerations* have not been discussed. As can be inferred by the time periods mentioned in section 7.3 for finding a successful reformulation, an unexpected withdrawal of a critical important chemical can pose considerable problems for textile companies if their clients are not willing or able to go along with the required substitution / reformulation changes. Both with (final) consumers and industrial customers the textile manufacturer may face a competitive disadvantage vis-à-vis the (non-EU) manufacturer which is not required to make similar changes.

The very (price and time) competitive consumer market is to a large degree governed by fashion cycles. The periods for reformulation are not compatible with the fashion cycles of many textile products for the consumer market. Unexpected changes will therefore mean very considerable market losses. Expected changes may be accommodated for specific products at the start of their fashion cycle, but missing out a number of orders in between may burden the long term relation between the EU textile supplier and the EU retailers.

For industrial applications, such as textiles for the automotive industry, the required product cycles are considerably longer, but functional changes halfway the client's investment and product cycles, can be very costly and cumbersome. The clients will therefore insist that the textile supplier will guarantee the quality of their product while the executing the required performance tests may take years to complete. In the meantime, the outstanding risk stays with the textile manufacturer.

Furthermore, textile finishers clearly indicated during the interviews that their customers in many cases would not even allow them to substitute substances in their recipes and processes due to the *existing certifications of the final textile products*. This is especially the case with technical textiles such as automotive textiles and also in the meantime with apparel industry which have established certified apparel qualities regarding consumer safety aspects. Therefore, a lot of additional legal implications may be the consequences for an intended substance withdrawal or substitution. This was a clear outcome of the interviews.

Another negative aspect could be the risks related to *the culmination of adaptations*, coming in two basic forms:

- Firstly, there could be a ripple of changes through the supply chains as adaptations higher up the supply chain have different lead times.
- Secondly, at registration deadlines of the phase-in periods of REACH an enormous concentration of reformulation activities could occur.

Both instances will significantly influence the reformulation efforts within the textile finishing industry, Reminding the complex recipe structures like given in Fig. 5.4-5.8 which contain a variety of different textile auxiliaries and dyestuffs from many different single suppliers, it is hard to imagine that they will be able to coordinate their withdrawal decisions for a single clients single textile article.

7.5 Substitution and related Environment, Health and Safety aspects

Another interesting aspect to be pointed out is the potential substitution of substances which have already substituted other supposedly or apparently more harmful substances in the past for environment, health and safety (EH&S) reasons (private labels, voluntary arrangements et cetera). This case shall be discussed on the example of the critical substance "benzylbenzoate" (for details see Annex 8). Benzylbenzoate appears to have a more favourable set of intrinsic properties than the dyeing carriers it has replaced in the last decade. In the past, at least in Europe, the dyeing carriers had been based on other active ingredients which possess more or less severe toxic and/or ecotoxic properties. NPV analysis reported in chapter 6.3 has demonstrated that benzylbenzoate is found to be vulnerable to withdrawal from the market for commercial reasons, depending on the assumptions regarding certain economic parameters. Substitutes are not known or under development at the moment. Therefore, there is some elevated probability that under the REACH pressure according to the result of the NPV analysis the whole production of the dyeing carriers based on benzylbenzoate will be shifted outside Europe.

Regarding the development of new environmental or consumer friendly substances and packages based on the interviewed chemical companies indicated that they see no reasonable chance in REACH to get enough incentives and opportunities for. In very rare cases this might work and has indeed worked, but voluntarily and not under registration pressure. The basic problem is that the chemical synthesis principles are already widely used and new molecular design will always have "exotic" chemical character which is normally related to adverse EH&S properties. *Taking out adverse EH&S activity means nearly always taking out of reactive groups and therefore functionality*. Only in combination with an appropriate foreseeable market potential and price of the new product there might be a slight chance. But again, as further outlined in chapter 8, there are clear obstacles as the needed registration costs – for exactly that reason there have been practically no new registrations even under current chemical law during the last two decades – and the new trend to provide new textile properties based on formulation and application know-how.

8 The outcomes of the business cases: Competitiveness, Innovation and communication and cooperation in the supply chain

The REACH registration requirements themselves as well as the corresponding costs and reorientation of textile chemicals portfolios will widen effects on the competitiveness and innovation potential of EU textile chemicals manufacturers and EU textile finishers. This is further explored in the sections 8.1 and 8.2 (for textile chemicals and textile finishers respectively). REACH will also have an impact on how the two industries communicate and work together in the value chains that bind them together, as well as the distribution of the margins between them..As a further result of substance substitution and therefore substitution of all the packages related to - in the consequence also valid for all substances and packages kept on the market – there will be raised supposedly some communication and confidentiality issues as well. These are discussed in section 8.3. In section 8.4 will be shown how all these needed efforts will cope with the EH&S competence and capacity in both industries. The chapter ends with an outlook on potential benefits from REACH for the textile chemicals and textile (finishing) industries.

8.1 Innovation and competitiveness of EU textile chemicals companies

Competitiveness of EU textile chemicals and textile (finishing) firms closely related

The short description of the European textile production at the beginning of Chapter 3 already underlined the importance of textile chemicals innovation for the competitiveness of the European textile firms, which face global competition mostly on price and costs. It should be noted that the close ties with the textile chemicals firms is conducive to the innovative capacity of textile firms, but also that these cooperation takes place in the context of what primarily is a commercial relationship. The fact that textile (finishing) companies purchase most of their textile specialty chemicals from EU companies, points to a home market advantage.

The next section will discuss in some detail the competitiveness and innovation potential of the EU textile sector. Later sections in this chapter explore the close ties within the various supply chain.

The impact of textile chemicals contained in imported textiles

Textile chemicals firms expect to incur a competitive disadvantage vis-à-vis non-EU competitors through the arrangements in It is true that textile chemicals imported to the EU face the same REACH requirements as those manufactured in the EU. However, they believe that the “substances in articles” arrangement in REACH is flawed, not only because they see it having serious problems with compliance and workability but also because they perceive it will not achieve a level playing field for supply chains totally within the EU and those partly outside of the EU nor that it is conducive for the level of environmental protection in the EU as intended by REACH. This “substances in articles” arrangement starts to apply at a later stage than the registration obligations for textile chemicals made and / or used in the EU (namely after 11 years and 3 months after entry into force), ;moreover, the threshold of 1 tonne per year is crossed more easily for an EU textile chemical substance than for the corresponding substance contained in imported grey textile (types) or textile article (types) . This problem is aggravated by definition, information and monitoring problems for chemicals contained in imported grey textile or fully finished textiles. These aspects will be further outlined from a more technical perspective in the cases presented in Chapter 9.

The innovation potential of textile chemicals seen from its historical context

Other aspects regarding innovation in textile chemicals industry can be only understood from a more historical viewpoint. The following short review and its conclusions are based partly on the interviews as well as on the detailed and long term experience of the consultants concerning these aspects.

First innovation phase

In the post-war period up to the early seventies, the innovation potential of the textile chemicals industry was mainly based on the introduction of new substances driven by the exploding demands of the textile industry and, ultimately, by the consumers preferences for more comfort as well as safety in daily life. This was the time where the early, in some cases rather primitive versions of easy care resins, softeners, flame retardants or even fluoro-chemicals have been developed. EH&S aspects were certainly not a priority during these booming times. The formulation of these substances was only needed to make them applicable in the textile wet processes.

Second innovation phase

After the current EU chemicals regulatory regime (the “new chemicals” directive) was taking its shape, the development of new substances was abruptly halted. To illustrate the drastic change: one of the interview partners has not registered any new substance since then; another one has registered only one new substance (which never got a profitable product due to the registration costs and lower market shares than expected); and a third one has registered only a few, mainly dyestuffs. This halt in the introduction of new substances on the textile chemicals market is not taken to mean that the R&D did not generate innovations Invariably, economic and marketing considerations quite similar to the NPV analysis always rejected these new substances. The industry had therefore to look for ways so as to circumvent this barrier.

Third innovation phase

One clever approach to pass by the chemicals law restrictions was to emphasize the development of polymeric versions of the active substances, perhaps in some cases so far as to the point of abusing the broad definition range of polymers. The consequence was that some time later the so-called “no-longer polymer” had to be defined.

Fourth innovation phase

Another solution to escape from the innovation trap described above was to modify existing EINECS registered substances in an appropriate way so that they were still covered by the registered CAS number (regarding this aspect see for chapter 3.2.1, technical grade substances). Often, the definition of the CAS number in question was helpful, as it merely contained the phrase “reaction product of……” encouraging the cover of all kind of technical grades based on the same chemical raw material basis. However, for responsible chemical suppliers, this cannot be a sustainable solution.

Fifth innovation phase, current situation

As a consequence, during the last decade the innovation potential in textile chemicals gradually changed to intelligent technological solutions based on more or less complex formulations ("packages") and application recipes. In some current cases, this has reached levels close to perfection: some "packages" on the textile finishing market are highly intelligent "all in one recipes" (containing up to 30 substances) providing perfect customer service. However, this strategy may render the textile chemicals supplier dependent on the vicissitudes of his specific customers. The reader of this report will find a typical example in the real-life value chain mentioned inr section 5.2.1 and depicted in Figure 5.4 (all-in-one softener).

According to the interviewed firms, REACH poses a particular challenge to these kind of innovative "packages" as it may force the supplier to disclose (part of) his most advanced know-how. They see the most modern innovation potential of their industry (potentially) endangered by REACH: on the one hand, through opening the knowledge of how to make a formulation with a certain special effect; and on the other hand, by limiting the toolbox of active ingredients / critical specialty substances required needed for further development in of these highly specified formulations which is seen as essential for the innovation power of their own and of the European textile industry and thus for their competitiveness on the Euroepan and global markets.

This is certainly one of the core issue of textile chemicals industry of today: how to combine the needs of REACH for EH&S improvements and also for the technical and marketing needs of the downstream users under REACH.

The companies see as a the unintended transfer of specific textile chemicals knowledge to the non-EU competitors of both industries, EU and non-EU. Without the competitive edge of top know-how ensured, they regard it as difficult to compete with the fierce competition coming from the Far East. These competitors already exploit their advantage of cheaper raw materials and labour costs.. For that reason, all the major textile brands in the world already have their contractual production located there and no longer in Europe. The advantage of the EU textile chemicals suppliers and textile finishers is their edge on the know-how of intelligent formulations and recipes;

8.2 Innovation and competitiveness of European textile finishing

The finishing sector is one of the very few sectors in which some competitive advantage of the European textile manufacturers could be preserved. The finishing phase requires a set of skills, know-how and innovation that make possible to "resist" to a fierce "price competition". This has already been explored in the previous section. This section outlines the significant efforts of the recent years of the European finishing industry aimed at maximising its know-how so as to reduce costs while keeping a competitive edge on the "innovation and quality" fronts.

The interviews have confirmed that the following actions have already been put in place by most of the European finishers:

- rationalization of production process and optimization of recipes in order to lower the consumption of chemicals (this policies has been implemented by all the interviewed companies);
- launch of new products in substitution of old products in order to set a "new" price and make impossible or difficult a comparison;
- provision of "extra quality" for the same price (higher product performances or better services);
- differentiation of the pricing of the product according to the bargaining power of the client.

The overall competitiveness of the European textile and clothing industry has come under strong pressure. The market shares of the European manufacturers are fast shrinking, because of the price competition from outside the EU, especially from the Far East. It is a generally accepted fact that the difficult situation of the European textile and clothing industry is structural and not a temporary, cyclical phenomenon. The finishing sector is one of the very few sectors in which some competitive advantage of the European manufacturers could be preserved.

8.3 Communication and confidentiality issues in the supply chain

This section will further elaborate what REACH means for the communication and confidentiality issues on the basis of the interview results. Generally, the interviews confirmed the consultants' experience from earlier work that the textile finishing industry needs to call upon expert services from their chemicals suppliers for special use applications. In this sense, there is a close cooperation within the supply chain. However, the findings also indicate that this cooperation and knowledge sharing has its limitations.

One reason is that compared to earlier times the chemical suppliers today do nearly no more provide special EH&S services for low volume chemicals sales which represent clearly the majority of this business in Europe (low scale innovative and individual textile products). Typically about 80% of the chemicals and dyes number supplied downstream are related only to 20% of the all-over consumption of chemicals and dyes in a textile finishing firm. The value of a single drum of a textile auxiliary is typically about 200-400 Euro. Even a margin of 50% allows no more any kind of special services for this product and its possible special use even without REACH under current legislation.

Another more important reason is that in the interviews with the textile finishers, certain rather specialized applications of the investigated critical substances were identified which were clearly unknown to their chemicals supplier, even as potential uses. The interviewed firms made it clear that they consider these special uses as vital business secrets with the view of their market position vis-à-vis their supplier (who would otherwise be able to appropriate part of the rents of this innovative use through higher prices for the substance and associated services) and vis-à-vis their competitors (who could simply copy the innovative use without incurring search and development costs). The existence of these special uses as such can also be seen as a positive indication of the innovative capacity and competitiveness of textile finishers, and as a measure of independence in their commercial relation with the chemical industry.

Under REACH, the textile finishers may face a dilemma. If a textile finishing firm wishes to ensure the confidentiality of the special use, he cannot reveal it to his supplier as an “identified use” in order to bring it under the latter’s exposure scenario of the substance. In this situation he will have to report this special use to the Agency; in case the involved substance is imported, he may even choose to become legally the direct importer and thus to register the substance on his own. However, the interviewed firms were currently lacking the required capacity and expertise to take on these REACH obligations themselves. Either hiring new personnel or relying on the services of external consultants would increase costs to the textile finisher. Moreover, the availability of such experts on the labour market is also limited.

This raises the possibility whether textile finishers could build upon the already close ties with the suppliers of their substances. The interviewed textiles firms expressed their serious concern that in order to get a workable exposure scenario they would be required to hand over too much data to their supplier. They say that the supplier of the substance in question will require information on the recipe and process conditions in order to be able to assess potential interactions of his product with others in the recipe, and even information about the textile material to be processed. Textile finishers regard this information as a business secret, not only as part of their innovation know-how but also as sensitive market information on the quantity and quality of his inputs. Alternatively opting for a rather wide exposure scenario (which requires the willingness of the supplier to take on this responsibility) will provide the textile finishers only with instructions based on common uses, which likely do not cover the specific innovative use. The firms assess that under REACH the combined EH&S exposure results from their process will clearly stay in their own responsibility, as is the case already today with isolated environmental issues.

8.3.1 Example: special use of melamine resins

Following example based on the application of the critical substance melamine resin gives a certain idea about the wide range of functionalities of innovative textile auxiliaries respectively their active components of today. Even if many textile chemicals producer have melamine resins in their gamma they think of maybe only one or two of all these special uses given below.

Melamine resins can be typically used as

- Easy care resin for non ironing finish

  EH&S exposure depending an process parameters as drying and curing time, process temperature, textile material, machinery

- Cross-linker in flame retardant processes
- Cross-linker in many other processes
- Coating of technical fabric with subsequent drying intended for additional curing further downstream with an automotive textile supplier
- Hundreds of possible reaction partners
- Ends up always as a polymer on textile article (exempted coating/drying)

All these special uses will lead to different EH&S assessment results especially if it comes to further downstream user and especially consumer risks. This is indicated by the message of the last bullet point above. The special use process conditions and recipe combinations decide about the polymerization grade of the final crosslinked melamine resin. This is exclusively in the responsibility of the textile finisher and can never be covered by the supplier of the melamine resin.

The interviewed textile chemical manufacturer of the value chain E (see chapter 5.2.5) for example delivers this kind of melamine resin to nearly 100 European textile finishers. This gives a rough idea about the communication challenges only for one single substance. Only after having communicated in detail all the application processes and recipes of these 100 clients the chemical supplier would be able to provide a full CSR/CSA covering all the related identified uses.

8.4 Environment, health and safety competence and capacity

The interviews with the *textile chemicals firms* gave the impression that they are as prepared as currently possible for the regulatory and technical aspects of REACH. The average number of EH&S staff is in the range of 1 to10 for SME to large firms. These people are highly specialised and can therefore be expected to understand and work with the REACH requirements. However, they have also indicated that their current workload is already considerable due to cuts in EH&S personnel and the growing EH&S work required by the exiting legislation. They also pointed out that they have had only limited experience with registrations and testing of substances under the Dangerous Substances Directive 67/548/EEC, as they have not developed and / or produced so-called “new” substances. Another interesting workability aspect is the at least potential formation of consortia. One large interview partner indicated that there is a principal chance for about 300 substances out of his gamma of nearly 900 to start consortia discussion, independent of the principal problems with consortia regarding substances of technical grade. This would mean that high manpower and much time is needed only to discuss the possibility of consortia formation with a high risk that the outcome is negative.

The interviews indicate that the EH&S competence and capacity within the *textile finishing industry* is much less rosy. In some of the firms, only 0.25 full-time-equivalents is available for EH&S issues, which is just sufficient capacity to take care of the SDS and to provide basic occupational health services. In line with the professional experience of the interviewers, the interviews also confirmed that only very few textile finishing companies have hired a trained chemist, and that, in those relative rare occasions the hired chemist had to spend more time on R&D than on EH&S issues. The largest EH&S staff encountered was 5 persons. The EH&S staff present seems to lack the required competence for executing REACH requirements such as hazard, exposure and risk assessments. It appears that textile finishing companies have outsourced most of their textile chemistry expertise, which has rendered these firms dependent on their textile chemical suppliers for executing non standard EH&S tasks. This will require close contacts with the textile chemicals suppliers, which may, however, get in conflict with the necessity to keep their know-how on the use of these chemicals as confidential.

8.5 Potential benefits from REACH

Concerning benefits from REACH principally all interviews partners from both industries first answered in a clearly negative way as “no benefit at all”. One of the given major arguments was that due to the existing regulations regarding EH&S and the associated activities of the companies like EH&S like many different kind of control and risk measures concerning occupational health, waste water emissions, air emissions and consumer safety no further benefits are to be expected. The consultants tried to challenge the interview partners with a couple of ideas about potential benefits which have not been regarded as completely impossible from the project partners.

The *textile chemicals companies* pointed to the business benefits of REACH which are related to their increasing knowledge about the real application conditions of the downstream users. This could have a positive impact on product liability and quality issues which often have to do with incomplete or asymmetric information on downstream user process details.

Furthermore, more knowledge on the specific uses of textile chemicals within textile finishing could trigger new product development on the chemical suppliers’ level. However, this benefit may be in conflict with the direct commercial interest of specific textile finishers who need to keep their special application confidential.

The *textile finishers* on the other hand pointed to the business benefits of REACH which are related to their increasing knowledge about the actual composition of the textile auxiliaries and dyestuffs. This could have a positive impact on product liability and quality issues as well which often have to do with incomplete or asymmetric information on the chemicals inputs. Furthermore, more knowledge on the composition of specific textile chemicals could make them better comparable and the market for textile chemicals more transparent. This would make the simplification of and the substitution in recipes easier, as well as the negotiations on price and service condition with their suppliers. However, this may conflict with the direct commercial interests of specific textile chemicals suppliers.

9 Substances in textile articles

The European textile industry will be confronted with the “substances in articles” arrangement of REACH (article 6) at different stages of the textiles production process. Since article 6 in REACH also specifies that the arrangements in that article will not apply to substances that have already been registered for that use, “substance in article” issues are likely to be most prominent at the import of textile intermediaries from outside the EU. Therefore, of the four cases discussed in this chapter, the first two outlined in sections 9.1 and 9.2 are the most important ones:

- *Imported fibres and yarns to be further processed in the textile finishing industry,*
- *Imported intermediate fabrics to be further processed in the textile finishing industry,*

The other two cases discussed in sections 9.3 and 9.4 are more relevant for the situation of the apparel and other textile downstream users.

- *Import of ready to use articles, mainly as apparel*
- *Production and distribution of fibres, yarns and fabric intermediates in Europe*

In the following sub-sections, these four issues will be discussed in some more detail. The information partly comes from the interviews (see additional questionnaire in Annex 7), and partly from the expertise of the consultants. In each case, there is potential for some competitive disadvantages to arise for EU textiles firms vis-à-vis non-EU competitors. Potential EH&S issues also arise in some cases.

In advance to the following discussion and to avoid any possible misunderstandings it has to be clearly said that the basis of the textile articles themselves is always to be regarded as a polymer and sofar is out of the scope of the article 6 definition. The question is the potential existence of substances in this textile polymers (natural or man-made).

9.1 Imported fibres and yarns to be further processed in the textile finishing industry

Fibre and yarn processing with the input articles coming from outside the EU, mainly from the Far East, is nowadays a very common practice. European based importing houses currently take care of this import; they will also be the legal entity which has to cope with the relevant REACH requirements. However, as of now, the term “article type” has not been very well defined. Nobody can say with any certainty whether a fibre or yarn type will be defined from a technical perspective or whether it will be the chemical properties that define an article given by the substances on this article.

Furthermore, the following example shows that importers and EU manufacturer of the same fibre or yarn input may not be treated economically in the same manner. The production of synthetic fibre or yarn articles involves two typical potentially hazardous substances, antimony trioxide (used as a catalyst in polyester production) and N,N-dimethylformamide (used for spinning of polyacrylonitrile fibres). The technical production requirements indicate that in order to pass the threshold of one tonne per year, one would need an imported amount of about 3000 tonnes of polyester articles and about 300 tonnes of polyacrylonitrile respectively. Especially in the former case, the imported amount is fairly high for one single importer.

In both cases of the example, the release of the substances is not intended but likely under finishing process conditions. Article 6 says that a notification is only required if the amount of the release may be harmful to man or environment. Importers could be unable to draw the conclusion that this is not the case, since it is only in fact the textile finisher who may know the potential for actual release.

The conclusions are

- Due to the foreseeable needed narrow definition of a single article – otherwise too many substances at the same time will have to be regarded on the same article – its specific volume will be always low and therefore also this of the substances in the article

- As a consequence there is a high probability that there will be no consequences for the importer because never being able to reach the 1 t/y substance threshold
- Compared to this the European based same article will be indirectly hit by REACH through the registration needs for the same substances, in any case much earlier

9.2 Imported grey fabrics to be further processed in the textile finishing industry

This case is similar to the one in the previous sub-section.

- However, much more complex because fabrics are often times based on different yarns and additional chemical substances used for fabric making
- Even the same polyester based fabric might have been made from different polyester yarn types with again different substance concentrations in the article
- No importer would ever be able to solve this problem without the knowledge about the actual fabric composition and this of the basic yarns without constructive help from the original yarn and lubricants producers maybe sitting in Far East

However, independent of this complexity issue the basic interest lies more in the substances with intentional release during the production phase in the textile finishing industry of pre-treatment prior to dyeing. Certainly, the main components of these substances, sizes and lubricants, are polymers but some other ingredients have an impact on waste water. Existing environmental studies as already outlined in chapter 3.3.2 and 3.3.4 show that these sizes and lubricants and their ingredients contribute typically to about 60 to 80 % of the whole waste water problem of a single textile finishing plant (Annex 1, EnviroTex projects list). However, till today, the finishers have not received sufficient information from the importers or original manufacturers about these substances and their concentration in the imported fabric articles. Thus, in this respect REACH could bring a realistic change for the better.

However, the same arguments as those in the previous chapter apply also here. The arrangements do not therefore put much pressure on the importer to reveal the exact content of the articles and the (hazardous) properties of the substances contained therein.

9.3 Import of ready to use articles

Here the situation is rather clear-cut. Since this concerns consumer articles, it is very likely that in case they contain hazardous substances (based on the knowledge of today, might be different after a potential REACH registration), their concentration range would be in the lower mg/kg concentration range. For example, with a concentration of 1 mg/kg, one needs 1.000.000 t of article per year to achieve the threshold of 1 tonne per year. Even a big importer will not reach this volume.

A good example is DEHP (Diethylhexylphthalate) used in T-Shirts prints, without implying that DEHP is a risk for consumer. As the print material typically contains just 2 % DEHP content, and one needs 5 g of that material for one shirt, it would require about 10 million of these T-Shirts to reach the threshold. These volumes are normally beyond the reach of even large brand importers. However, the same T-Shirt produced in Europe could face a cost pressure due to the REACH requirements including a consumer exposure scenario, with the registration and testing costs also passed down in the chain.

The situation might complicate in a real challenging way if it comes to complex articles as a jacket for example composed of about 10 single sub-articles which are again based on fabrics or similar and their associated yarn composition.

Compared to this the European based same article will be indirectly hit by REACH through the registration needs for the same substance. The probability to exceed the 1 t/y substance threshold at the source of this substance is much more higher.

9.4 Making and distribution of fibres, yarns and fabric intermediates in Europe for further downstream use

In chapter 8.3 the issue of keeping specific uses confidential has been discussed. Since article 6 applies when the use has not been registered (even if the substance has been registered), this issue also crosses over to the question of substances in articles.

Now, the European fibre, yarns and fabric producer faces similar problems as the importers in the previous cases, starting with the definition of what exactly is an article type. The difference with importers is, however, that article 6 will apply (11 years and 3 months after REACH enters into force), the producer will have the basic information on the hazardous properties of the substances in the preparations used for finishing from the upstream supplier. What he doesn´t have is their specific behaviour in the process to which extent they adsorb to the textile article and/ or how they react with it and other substances. This remains his own responsibility but it is not easy to assess with any precision. Consequently, the manufacturer runs the risk to be faced with the considerable burden and expenditure of an appropriate analysis of all the involved substances including their specific exposure behaviour to consumers.

A further potential workability and communication issue should not be underestimated. According to article (6), 5 no activities are needed if the involved substances on an article have been already registered by an upstream supplier. The probability in Europe for this is undoubtedly high. However, to prove this means an additional challenging communication effort in the textile value chain from the very beginning on because the upstream supplier has to register the substances involved in this process and the possible downstream user exposure scenarios. This is especially challenging for apparel if consumer safety aspects have to be assessed.

10 Special issues for SMEs

The material of the study indicates that SMEs in the textile chemicals supply chain will face special challenges from the REACH registration requirements. Most of them will be downstream user companies within the textile finishing industry, as there are only a few SMEs within the textile chemicals industry. Most of the companies in the latter sector are of medium to large size and these companies clearly cover the majority of the textile chemicals sold to Europes´s textile finishing industry (as proved by the interviews and the ensuing evaluation of the supplied chemicals purchasing lists).

10.1 Issues and recommendations for SMEs within textile chemicals industry

Companies in the textile chemicals sector will have to register many of substances of their product portfolio. The survey of Chapter 3 points to the wide variety of textile chemicals on the European market supplied by mostly European textile chemicals producers. For a part, this differentiation is a consequence of the vertical integration of (part of) the formulator stage in the textile chemicals supply chain. However, the business cases results presented in the Chapter 6 to 8, include the notion that the number of suppliers for a specific self-made critical ingredient of textile chemical "packages" also seem to be very limited. Thus, also on the substance level the degree of differentiation seems to be quite high.

Admittedly, the sketch above is about textile chemicals companies in general, but many of the findings reported in this study and referred to in this chapter appear to hold for the smaller of the interviewed companies as well as for the largest one

According to the table in chapter 3.2.1 which describes the number of substances attributed to the different REACH volume ranges the major challenge for a SME but also for a large chemical supplier will be the lower volume ranges 1-10 t/y and 10-100 t/y. It is true that no substance of the 1-10 t/y category turned out to be selected in the identification process of the real-life supply chains[12], but there is no reason to assume that REACH challenges found for the 10-100 t/y category would not carry over to the lowest volume category. To illustrate this point, the registration and testing costs per tonne seems to be roughly equal or higher in the 1-10 t/y volume band.

As the largest part of the production portfolio of the textile chemicals companies is concentrated in the lower volume bands, the vulnerability for the lower volume critical substances, as found in the investigated sample, points to the issue of the registration costs per substance. Simplification of the registration procedure and lowering the registration costs for this volume ranges should help to reduce the incidence of substance vulnerability and consequently the risk of substance withdrawals which may trigger an accumulation of required product and recipe reformulations as well as process redesign efforts with corresponding costs burdens, both in the textile chemicals sector and further downstream in the textile finishing sector. In particular, SMEs in the latter sector could be overburdened if this rationalisation process would be uncontrolled.

The substance definition in the registration requirements must play a crucial role in any attempt to relieve the registration and testing burdens, as the issues of impurities and technical grade of the textile substances appear to be major obstacles in the REACH facilities to keep the registration and testing costs in check. Specifically, there must be found a way to group textile chemicals substances which addresses the need for a larger tolerance regarding the by-product profile. If this is possible, the "OSOR" approach (one substance-one registration) and consortia formation will face fewer difficulties and could achieve significant cost savings. It is fair to say that the reported problems in applying QSARs and similar alternatives to testing will still stay difficult

Another important aspect will be the total amount of registration and testing costs for a SME, i.e. for all the substances to be registered combined on or around the same time. To illustrate this point: one of the participating medium sized textile chemicals company had calculated that its total costs would amount to somewhere between 15 to 25 million Euro which

[12] This is perhaps due to the selection criterion that only those textile chemicals should be taken into account that significantly contribute to the company's turn-over ("key preparations" according to the IPTS methodology [7]).

corresponds 10 to 20 % of the actual annual turnover. Even its costs assumptions are arguably overly pessimistic, it still points to the significant finance bottleneck SMEs may face.

Moreover, the interviews learned that the notion that the REACH costs can be seen as an investment is not shared by companies, as accounting principles dictate that they have to amortise the sum within one single year. This situation certainly raises some finance aspects as already addressed earlier. As SMEs usually have limited financial resources and less access to financial services and to the capital market than larger firms advantageous, the REACH registration costs could overburden their (short-term) funding capacity.

The identified problems in communication within the textile chemicals supply chain, specifically regarding the mentioned downstream uses and the obligation for suppliers to provide an exposure scenario, could be addressed by the definition of appropriate exposure categories. At least, this was the idea of almost all of the interview partners as they felt that such an exposure scenario could cover most of the foreseeable special uses and so could help to reduce the costs and time taken up in the upstream/downstream communication. However, this may not be so easy as many challenges need to be tackled such as the many different textile qualities, hundreds of process conditions, the lack of information on chemical cross-reactions from substances coming from different “packages” and textile chemicals suppliers or, significantly, already contained in the grey textile, the enormous spectre of (industrial) consumers et cetera. The greatest challenge, however, will be to prevent that the REACH idea would become too diluted by exposure scenarios which are so broad that they can hardly be expected to address specific uses in a meaningful way..

As this concerns a technical issue, a European expert group should be installed to do this. This group should especially facilitate the obvious confidentiality issue in the supply chain..

In addition to the cost and workability factors mentioned above, the REACH requirements may also create a human capacity problem, as the people with the required are limited in number (especially for SMEs which typically have only one person in charge for EHS issues). The recent market pressures on the sector seems to have reduce this capacity even further. In one interview case a medium sized company confirmed that during the last years they have halved their personal stuff for R&D and EH&S .

Another particular challenge for textile chemicals SMEs will be the possibilities and its capacities to participate in the registration consortia. The technical and (financial and human) capacity problems mentioned above are also relevant here, since a SME portfolio indicates that it may have to join dozens of such consortia. Clear standard rules for sharing data and the consortia costs are required, as well as adequate safeguards for SMEs as the smaller members in such a consortium.

10.2 Issues and recommendations for SMEs within textile finishing industry

In addition to the discussion above which is also relevant for textile finishing companies as they are indirectly affected, the following presents a few issues and recommendations are discussed which focus more directly on the needs of the SME textile finishers in their capacity as downstream users of the registered textile chemicals.

As already outlined in chapter 8.4, the human capacity in terms of man power and expertise required to deal with the downstream user obligations in REACH is clearly limited within the textile finishing sector. The observed general trend to reduce the internal EH&S capacities is similar or even more dramatic as with the chemicals SME firms. For small companies the capacity is close to zero already. Consequently, handling the REACH downstream user obligations would imply two rather unattractive options, firstly relying on external expert capacity which is expensive and has limited capacity, or to ask the chemicals suppliers themselves. However, the latter option provokes the confidentiality issues as already pointed out in chapter 8.3. These are pertinent for small textile finishing companies which usually exist only because of their very special, sometimes even fully unique recipe and process know-how.

These idiosyncratic uses of textile chemicals bring the risk that their chemicals suppliers will not cover them which would mean that these companies would be compelled to notify with the Agency. Not only the already mentioned limited human capacity is a bottleneck here; these firms usually lack (all) experience with similar lack of regulation procedures, as they have mostly relied on their experienced suppliers to provide this service to them.

Consequently, intensive training and education on the relevant REACH aspects is necessary for the European textile finishing industry as well as the development of the appropriate easy-to-use IT tools. Facilitators with appropriate and equal experience in the fields of textile chemistry, textile finishing and the environment, health and safety should be identified to help to install, bolster or disseminate local service competence. Perhaps, the national industry associations which have already proved shown their interest in the REACH process on other fronts, could play an important initiating role here.

As explained in chapter 7, any pass-through of the REACH registration and testing costs from the textile chemicals suppliers towards textile finishing will have a significant impact on textile finishing companies, because the use of chemicals constitutes an important part of their production costs and their capacity to pass on cost increases further downstream through price increases is limited (just as is the case for textile chemical suppliers for that matter). It should be noted that smaller companies tend to have limited market power or power to “open up” running contracts and also a limited financial buffer to absorb the costs.

The fierce competition on the textile article market and the growing pressure from supply form the Far East on many textile markets is the main cause for the limited capacity to bear a part of the REACH registration and testing cost and particularly a concentration of process and product reformulation costs. Apart from the consequences of reformulations on the time-to-market capacity, REACH may aggravate the pressure on competitiveness of SME textile finishers through the “substance in articles” arrangements as stipulated in article 6 of REACH. Firms expect to incur a competitive disadvantage in particular, through the later starting date of this arrangement, namely only after the registration obligations for textile chemicals made or imported into the EU and used for textile articles production. This means that for a some time comparable articles form non EU countries will have not have the obligations or cost burdens which are placed on their European alternatives. This is a unique chance for imported articles to break into those parts of the Europes textile articles business which through shrewd innovation has been able until so far to counter the fierce price competition. Brands and retailers will clearly decide for the cheaper material from outside EU than appreciating the cost problems of their European supply sources.

These problems may weigh heavier on a SME textile finisher for the following reason. Due to the relatively low metrages per contract – sometimes for example below 100 fabric meters – such a SME will have to hold on reservation a relatively high amount of recipes as compared to larger companies. In the case that chemicals suppliers rationalise their textile chemicals substances, they may get stuck with useless stock as specific combinations of textile chemicals cannot be realised. Also, SMEs are likely to have much lower capacity to bear the risks regarding reformulations or even re-engineering of the textile products while satisfying his – often much larger - textile client downstream. SMEs will be far more intensively hit by this threat than larger companies (see also discussion in chapter 7.2).

11 Final conclusions

The business case studies point to the following potential issues regarding textiles supply chains.

Impacts of REACH on the textile chemical suppliers:

- A high proportion of critical low-volume speciality substances are vulnerable to withdrawal from the market. From the sample of 6 substances, only the high-volume substance was found not to be vulnerable under all of the alternative assumptions scenarios. Three substances were vulnerable under all of the considered scenarios and the other two were vulnerable under some of these scenarios These last 5 critical substances include at least one environmental and consumer friendly substance (benzylbenzoate) that has replaced over the recent years substances with a more negative toxicological and ecotoxicological profile (see chapter 7 and Annex 8). Of the 1500 (self manufactured textile chemicals) substances identified for use in textile chemicals preparations, up to 90% are produced in volumes below 100 tonnes per year, and by just 50 suppliers within Europe (section 3.2.1).

- The interviewed textile chemical suppliers have indicated that they wish to keep the functionality of the product portfolio intact. However, as they have said to dispose of limited possibilities to absorb REACH costs or to pass them on, some rationalisation of their portfolio will inevitably take place, in particular when entire packages need to be substituted due to the falling out of one or more critical components. The choice between substitution and de-selection will also depend on the expected future sales volumes of the substance concerned.
- Given the steady decline in the European sales volumes for most textile chemicals, there may be a particular incentive for manufacturers to accelerate the downsizing of their production, through the de-selection of clients and specific uses, in order to come under a lower volume band (section 6.5).
- Successfully substituting a withdrawn critical substance will take between 1 and 9 months and cost 5 000 to 100 000 Euro per new product. The costs for a reformulation of a preparation that contained the withdrawn substance will take up to 50 000 Euro. (see section 7.3). Based on the interviews, there seem to be only limited possibilities to absorb or pass-on the costs of REACH. Since the year 2000, both the volumes and prices of most textile chemicals have been decreasing. This trend is also exhibited by the analyzed six critical substances and their related packages (sections 6.3 to 6.7). Moreover, given the large number of clients and applications which the exposure scenarios of the textile chemicals company are supposed to cover, they perceive a great need for workable exposure categories and practicable IT tools (chapter 10).
- Vulnerability to withdrawal can usually not be mitigated by consortia building or the use of alternative test methods. This is because a substance can have varying technical grades and (eco)toxicological properties, meaning that many speciality substances are too complex or too differentiated to be included in the same dossier (sections 3.2.1, 6.2.3)
- The interviewed chemical suppliers pointed to a number of concerns on communication in the supply chain that will complicate registration of substances. These included a current lack of information on imported formulations and appropriate

feedback on identified uses, as well as undefined interactions between substances in finishing processes (sections 8.3, 9.4)

- An identified potential benefits of REACH is that more knowledge of the specific uses of textile chemicals within textile finishing could foster new product development by the chemical suppliers as well as having positive impacts on product liability and quality issues (chapter 8.5)

Impact of REACH on the textile finishers

- Most textile finishers are SMEs. As such, they have restricted financial and human resources to cope with the administrative requirements and necessary adaptations caused by REACH (section 8.4). They are concerned about the availability of critical substances and preparations because their competitiveness depends on innovative uses of many of these specialty chemicals. The current difficult situation of the largest part of the European textile sector would compound these problems.
- As some degree of withdrawal of these critical substances and preparations will inevitably occur, textile finishers will face significant reformulation and process adaptation costs, which they cannot absorb nor pass on to their customers because of fierce competition in all textile markets (sections 7.3). The indications of the interviewed companies are in line with the sectoral data. Since the year 2000, both the volumes and prices of most textile chemicals and textile products have been decreasing.
- Reformulation and adaptation will take textile finishers between 3 to 18 months depending on whether or not they can limit the required changes to a mere refreshment of the involved “recipes”. These time-to-market problems will conflict with fashion cycles of consumer textiles and product cycles of the customers of industrial textiles. The costs of a reformulation can run up to 300 000 Euro (sections 7.3). Moreover, the textile finisher fear that the REACH induced rate of required adaptations may pose insurmountable problems. Firstly, they are concerned that there will be a culmination of these efforts and adaptations as the textile chemicals

withdrawals are likely to be concentrated at REACH registration deadlines. Secondly, they foresee a permanent strain coming from the REACH-induced changes at earlier stages of textile production which likely will have different lead times.

The textile finishers face workability problems associated with their downstream REACH obligations as all the alternatives available to them are potentially costly and/or may affect their competitiveness. The identification of use to their suppliers will involve substantial costs and human resources, as they make use of a large number of textile chemicals in an even large number of applications. An additional complication is the incidence of a large number of unintended impurities and by-products which are not necessarily known to the textile finisher. However, due to earlier cost rationalisations in textile finishing and the relatively small company size, the textile finishers only have a limited capacity and experience to carry out the required tasks.

- In particular, they have trouble identifying their uses to their textile chemicals' suppliers, which may involve sensitive and confidential business information. The textile finishers are not guaranteed that the exposure scenarios of their suppliers will cover their idiosyncratic and often innovative use of their textile chemicals. Moreover, when ingredient substances chemically interact in downstream-users' finishing recipes and processes, this can greatly increase the complexity of information required (sections 8.3, 8.4, 9.4 and 10).
- However, textile finishers don't see the notification of use to the Agency as an attractive alternative either to keep their specific use confidential. The reasons are basically the same as before: their own limited capacity and experience, and the shortage of suitable and reliable external experts with the corresponding costs (section 8.4).
- Textile finishers expect to incur a competitive disadvantage vis-à-vis non-EU competitors due to the arrangements in REACH for substances in articles. As this arrangement starts to apply after the registration obligations for textile chemicals made and used in the EU, and has serious workability issues, some of which are specific for

textiles, they fear that a level playing field will not be achieved without achieving the intended level of environmental protection. In the first place, article 6 starts to apply after 11 years and 3 months after the start of REACH. That is later than the required registration date of the EU textile chemical substances. Moreover, the threshold of 1 tonne per year is crossed more easily for a EU textile chemical substance than for the corresponding substance contained in an imported article or article type. This problem is aggravated by definition, information and monitoring problems for chemicals contained in imported goods (section 8.2 and chapter 9).

- An important expected benefit of REACH is an increase in knowledge about the actual composition of the textile auxiliaries and dyestuffs, which could provide a positive impact on product liability and quality issues, which are related to their increase in knowledge about the actual composition of the textile auxiliaries and dyestuffs. This could have a positive impact on product liability and quality issues which often have to do with incomplete or asymmetric information on the chemicals inputs and provide a better comparability of textile chemicals and a more transparent market. It also presents a greater opportunity to simplify and substitute chemicals in recipes (8.5) , as well as the negotiations on price and service condition with their suppliers. However, this may conflict with the direct commercial interests of specific textile chemicals suppliers.

Augsburg/Milan, December 16th , 2005

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