7.4.3.4 Paints Manufacturing

This sector (CORINAIR 94 SNAP source category 06 03 07) covers the manufacturing of all types of paints, varnishes and stains. A wide number of products, formulated to meet a variety of service requirements, are available to the professional contractor and the do-it-yourself consumer. Besides paints, varnishes and stains, the paint industry also delivers all kinds of products required for the preparation and the removal of paints, varnishes and stains. These products are destined among others to aircrafts, automobiles, ships, wooden and metal furniture, packaging, textile fibres, industrial use on tanks and machines, domestic use, etc. [6]

1 Technology Description

The raw materials used in the paint manufacturing process include solids, solvents, and resins. Solids provide the coating with colour, opacity, and a degree of durability. Binders are components which form a continuous phase, hold the solids in the dry film, and cause it to adhere to the surface to be coated. The majority of binders are composed of resins and drying oils which are to a great extent responsible for the protective and general mechanical properties of the film. For viscosity adjustment, solvents are required. Materials that can be used as solvents include aliphatic and aromatic hydrocarbons, alcohols, esters, ketones, and esters and ether-esters of ethylene and propylene glycol. Additives are raw materials which are added in small concentrations (0.2 – 10 %). They perform a special function or give a certain property to the coating. Additives include driers, thickeners, antifoams, dispersing agents, and catalysts. The function of each paint is the same whether it is based on alkyd or latex (based on styrene-butadiene polymers). The selection of which to use will depend on the substrate and desired performance. [cf. 4]

Within paint manufacturing, only the physical processes of weighing, mixing, grinding, tinting, thinning, and packaging take place, no chemical reactions are involved. These processes are carried out in large mixing tanks at approximately room temperature. [cf. 1]

The manufacture of varnish also involves the mixing and blending of various ingredients to produce a wide range of products. However in this case, chemical reactions are initiated by heating. [cf. 1] Varnish is cooked in either open or enclosed gas-fired kettles for periods of 4 to 16 hours at temperatures of 90 to 340 °C; in Canada, closed reactors fitted with condensers to minimise losses are the norm [3].

In general, the manufacturing process of solvent-based, high solids and water-based products is similar in all paint production plants and includes the following process steps [6]:

- dissolution of solid materials;
- mixing of different liquids or of liquids with solid materials;
- further mixing to fulfil required specifications regarding viscosity, colour and other characteristics;
- sieving and filtering of base materials, intermediate and end products.
The production technique of solvent-free powder coatings is different. Exclusively dry base materials are mixed batchwise with powder mixers, and are then extruded (homogenisation and compression). Due to the high temperature in the extruder, a liquid is obtained which is processed to small shivers via cooling and braking. These shivers are ground in so-called sieve mills to obtain the final product powder coating. [6]

2 Emission Sources

Emission losses in paint and varnish manufacture can arise from several steps in the process. Major emission sources are:

- fugitive losses during the manufacturing process,
- losses during filling and cleaning activities,
- losses from product clinging to the vessels and equipment, and
- fugitive losses during mixing of preparations and storage of solvents. [3]

The primary factors affecting emissions from paint manufacture are the types of solvents used, and mixing temperature. About 1 to 3 % of the solvent is lost even under well-controlled conditions. [cf. 1, 3]

Varnish cooking emissions, largely in the form of volatile organic compounds, depend on the cooking temperatures and times, the solvent used, the degree of tank enclosure and the type of air pollution control used. Emissions from varnish cooking range from 1 to 6 % of the raw material. [cf. 1]

The emission factor for the ‘uncontrolled’ manufacturing of paints and varnishes is 15 g/kg paint for a production mix including 45 % low solvent-based, 45 % high solvent-based paints, 10 % thinners [5].

In general, emissions from the production of paint in larger installations are relatively lower. Here, the batches are larger and closed processes can be used. However, the paint industry offers a broad range of paints and colours, which have to be produced in relatively small charges. [2]

3 Primary Emission Reduction Measures

Technical Aspects

The ratio of sales of water-based to solvent-based paints has strongly increased for the last years. This is due to several factors: over the past years, performance of water-based paints has been considerably improved, and handling characteristics have become easier, e. g. low odour, clean-up with soap and water. However, some problems do remain: final appearance of water-based paints does still not give entire satisfaction; furthermore, in some application fields such as interior decorative specialties and particularly wood coatings, water-based products do not match solvent-based paints.

According to paint manufacturers, the majority of their research effort concentrates on water-based product development. Most of the research focuses on improving the properties of water-based products, which are still inferior to the corresponding solvent-based products, such as high gloss enamels, varnishes, wood stains and finishes, and floor finishes. Also
NMVOC-free latex paints undergo intense development due to development in latex technology, inducing a progressive shrinkage of the market held by alkyds. [cf. 4]

Some emission reduction might also be possible by careful selection of slower evaporating solvents from the overall final mix, but the net contribution would be expected to be small [3].

**Economic Aspects**

It is assumed that costs of the indicated primary measures are negligible.

4 Secondary Emission Reduction Measures

**Technical Aspects**

To reduce emissions of volatile organic compounds from the manufacture of paints and varnishes, control techniques include condensers and/or adsorbers on solvent handling operations, and scrubbers and afterburners on cooking operations. Afterburners can reduce NMVOC emissions by 99% with regard to uncontrolled emission as given above. [cf. 1] Solvent storage tanks may be fitted with condensers to reduce evaporative losses [3].

In the case of small batches, the effort for production-site ventilation and waste gas collection might be considerable. Here, the NMVOC-concentration in the waste gas stream is very low and waste gas flow rates are considerable. For these application cases, incineration of NMVOC-laden waste gases might technically or economically not be feasible. At present, biofiltration for these application cases is tested in pilot installations. [2]

**Economic Aspects**

Investments and operating costs for condensation, carbon adsorption and incineration are given in the attached technical data sheet.

5 Side Effects

No side effects of primary measures have to be accounted for. Condensation, adsorption and incineration will result in increased energy demand. Off-site incineration of NMVOC containing waste gases, a currently approved practice in Canada, contributes to secondary emissions [4].

6 References


Technical Data Sheet