

## Recycled asphalt used for road resurfacing

CITY OF HAMBURG, GERMANY

### Procurement objectives

In Hamburg there has been a long tradition of road construction methods that use materials such as factory-made mineral aggregates from demolished buildings or incineration ashes. Since the 1980s, Hamburg authorities have worked towards increasing the use of granulated asphalt, which had been recycled from existing roads. Reclaimed asphalt pavement (RAP) consists of approximately 95% mineral aggregates and 5% bitumen.

The use of RAP began with the deeper, base courses of roads. After proof of performance was asserted and sound experience had been gained from these applications, granulated asphalt made its way to the more sophisticated and technically critical binder and surface courses. The City's final goal is to proceed from using less than 50% RAP in these layers to recycling of 100% of the original construction materials when refurbishing and resurfacing roads. Using RAP is especially significant for surface layers (wearing courses).

Hamburg prescribes the use of a minimum 35% white aggregates in order to brighten road surfaces and to have a colder, deformation resistant road surface in summer. The high cost of these aggregate materials increased the incentive to recycle more than just base courses. A more careful consideration of the whole process of asphalt production was also triggered by recent dramatic increases in bitumen prices. The City allowed a group of private companies, who originally came up with the full recycling technology, to test its use on public roads owned by the City State. After the quality was then tested by Hamburg's road construction authority, the City was reassured about the use of the 100% recycling process. Having renovated two other roads using this technique, a restricted tender procedure was conducted, with five companies invited to bid.

### Criteria used

**Subject matter of the contract:** The refurbishment and resurfacing of Mönckebergstrasse (of one of Hamburg's main roads)

**Description of works:** After the general properties of the material for reusing are tested, the surface course of the current asphalt concrete must be milled to a depth of 4cm. The material should then be transported to an asphalt mixing plant equipped with state-of-the-art RAP processing equipment. Due to the aging of bitumen in old roads, the binder has to be rejuvenated, which is achieved by adding a mixture of flux oil and wax. Low-temperature asphalt (warm mix asphalt) should be used, which helps to achieve an efficient and environmentally friendly asphalt production and laying process. This implies:

- A lower energy input
- Reduced costs
- Less CO<sub>2</sub> and other harmful emissions
- Improved health conditions for operating staff
- Less nuisance for residents near inner-city construction sites
- Lower wear and tear on mixing plants

It was stipulated that the temperatures during the entire production and laying process should be as low as possible. Whereas "normal" asphalt is produced at temperatures up to 180°C, warm mix asphalt needs only about 140-150°C.

### Background

The Free Hanseatic City of Hamburg was selected the [European Environmental Capital in 2011](#). Green public procurement principles are included in the City's overarching [procurement policy](#) and there are additional environmental contract requirements imposed by the City, which are specific to road construction.

Under German National Law on [Recycling and Waste](#), departments within local councils are required to increase the proportion of waste recycled. Furthermore, laws require the use of any recyclable material in the highest possible position of any value chain. Asphalt is a recyclable material and is therefore subject to this legislation. Hamburg has taken a significant step forward to encourage an increase of recycling rates in construction materials by establishing an [online exchange](#) for soil, debris & construction materials.



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### Results

This is the third project which demonstrates that Hamburg's goal to minimise the environmental impact of road construction by re-using reclaimed asphalt can be successfully achieved. Moreover, the construction method is economically viable. While Bitumen only constitutes approximately 5-6% by weight of the materials used in asphalt, it can contribute to over half of the total cost and this price tends to rise further according to increasing world oil prices.

All five of the companies invited to tender made a bid and the company that quoted the lowest price was awarded the contract. Under this project alone, Hamburg saved 30% compared to the costs for conventional road resurfacing, which in this case equates to approximately €20,000.

Although significantly cheaper to produce, the recycled asphalt has the same properties and durability as new asphalt. Also, the costly replacement of stones with a colour compatible with the architecture of Hamburg's Möncke-bergstrasse was avoided, as all existing materials were reused. Traffic disruptions and local air pollution associated with congestion was kept to a minimum, as the work was carried out in a period of only 36 hours over a weekend.

### Environmental impacts

Road construction has significant environmental impacts. Combustion of fossil fuels during manufacturing causes the emission of carbon dioxide (CO<sub>2</sub>) and nitrogen dioxides (NO<sub>2</sub>). This contributes to greenhouse gas (GHG) emissions and global warming, atmospheric pollution (ground level ozone creation and acidification) as well as nutrient enrichment. Also, the traditionally very high temperatures associated with heating bitumen consumes a large amount of energy.

Meeting Hamburg's objective of recycling 100% of all material when resurfacing roads implied significant environmental benefits. Use of recycled asphalt along with warm mix technology greatly reduces such emissions, as mineral aggregates do not have to be quarried and transported over long distances. Also bitumen does not need to be manufactured from mineral oil. The rejuvenating additives have their own carbon footprint, but this is far smaller than the benefits of avoiding quarrying and the use of fresh bitumen. Finally the recycled mix is manufactured at lower than conventional temperatures, which reduces energy consumption for manufacturing and paving.

### Lessons learned

The process described in this example is considered to be very innovative and other German cities have already voiced interest in doing the same or have already built similar roads.

In the future, the City of Hamburg intends to issue open tenders, rather than using restricted tenders for similar works. Now that suitable products are on the market, it is theoretically possible for any road construction company to carry out these works, but they will need to acquire additional skills to use them correctly. The process requires a great deal of expertise. Not only is the right manufacturing equipment needed, but also pre-testing of asphalt needs to be conducted to determine the chemical composition and physical state of the aged bitumen in a surface prior to it being recycled.

In this specific case, recycled asphalt was used on the same road it was originally taken from. However, a more efficient overall process needs to be developed to carry such procedures out on a wider scale, using recycled asphalt on other roads in the same city or region according to need.