REPORT

spin
Sustainable Production through Innovation in SMEs

Background paper on surface treatment-current status and development needs

Report for SPIN

DRAFT

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Content

Introduction

Metals are treated to change the surface properties for: decoration and reflectivity, improved hardness and wear resistance, corrosion prevention and as a base to improve adhesion of other treatments such as painting.

Surface treatment does not in itself form a distinct vertical sector as it provides a service to a wide range of other industries.

The range of components treated varies from screws, nuts and bolts, jewellery and spectacle frames, components for automotive and other industries to steel rolls up to 32 tonnes and over two metres wide for pressing automotive bodies, food and drink containers, etc.

No overall figures exist for production, in 2000 the large scale steel coil throughput was about 10.5 million tonnes and about 640000 tonnes of architectural components were anodised. Another measure of the industry size and importance is that each car contains over 4000 surface treated components, including body panels, while an Airbus aircraft contains over two million.

About 18000 installations exist in EU-15. A few large installations are owned by major companies although the vast majority are SMEs, typically employing between 10 and 80 people. Process lines are normally modular and assembled from a series of tanks. However, large installations are typically specialist and capital intensive.

Key environmental issues

The Surface treatment industry plays a major role in extending the life of metals, such as in automotive bodies and construction materials. It is also used in equipment that increases safety or reduces consumption of other raw materials (e.g. plating of automotive braking and suspension systems, plating precision fuel injectors for automotive engines to reduce fuel consumption, plating materials for cans to preserve food, etc.).

The main environmental impacts relate to energy and water consumption, the consumption of raw materials, emissions to surface and groundwater, solid and liquid wastes and the site condition on

The processes related to surface treatment are predominantly water-based and the consumption of water and its management are central themes, as it also affects the usage of raw materials and their loss to the environment. Both in-process and end-of-pipe techniques affect the quantity and quality of waste waters, as well as the type and quantity of solid and liquid wastes produced.

Although practice and infrastructure in the industry has improved, it is still responsible for a number of environmental accidents and the risk of unplanned releases and their impacts is seen to be high. Electricity is consumed in electrochemical reactions and to operate plant equipment. Other fuels are predominantly used for heating process vats and work space, and for drying.

The key emissions of concern to water are metals which are used as soluble salts. Depending on the process, emissions may contain cyanides (although decreasingly), as well as surfactants which may have low biodegradability and accumulative effects, e.g. NPE and PFOS. Effluent treatment of cyanides with hypochlorite may result in the production of AOX. Complexing agents (including cyanides and EDTA) can interfere with the removal of metals in waste water treatment or remobilise metals in the aquatic environment. Other ions, e.g. chlorides, sulphates, phosphates, nitrates and anions containing boron may be significant at a local level.

The Surface treatment industry is not a major source of emissions to air, but some emissions which may be locally important are NOX, HCl, HF and acid particulates from pickling operations, hexavalent chromium mist released from hexavalent chromium plating, and ammonia from copper etching. Dust, as a combination of abrasives and abraded substrate, is generated by the mechanical preparation of components. Solvents are used in some degreasing operations.

Applied processes and techniques

All but a few simple activities require some pretreatment (e.g. degreasing), followed by at least one core activity (e.g. electroplating, anodising or chemical processing) and finally drying. All processes have been developed for components hung on racks or jigs; some processes are also carried out on components in rotating barrels, and a few are carried out on reels or large coils of substrate.

Consumptions and emissions

Apart from some cooling systems, the major use of water is in rinsing. Energy (fossil fuel and electricity) is used for heating processes and drying. Electricity is also used for cooling in some cases, as well as driving electrochemical processes, pumps and process equipment, supplementary vat heating, work space heating and lighting. For raw materials, the usage of metals is significant (although not globally, for example, only 4 % of the nickel marketed in Europe is used in surface treatment). Acids and alkalis are also used in bulk quantities, while other materials such as surfactants are often supplied in proprietary mixes.

Emissions are primarily to water, and about 300000 tonnes of hazardous waste is produced per year (an average of 16 tonnes per installation), mainly as sludge from waste water treatment or spent process solutions. There are some emissions to air of local significance, including noise.

The situation in Sweden

In Sweden there are approximately 700 metal surface treatment installations of which one half performs chemical pretreatment before painting (i.e. phosphating and chromating). Most of these are mechanical workshops painting their own products.

The other half normally perform metal coating where the most common methods are electrolytic (zinc, chrome, nickel, copper), chemical (nickel, copper) or thermic (hot dip galvanizing). This is mostly done on lego basis, very few mechanical industries have an installation of their own for this type of processes.

Measures to avoid environmental impact

Sweden, like all countries around the Baltic Sea, has adopted the Parcom and/or the Helcom Recommendations regarding metal surface treatment. These recommendations which are more or less the same, stipulate requirements based on best available technology:

- Substitution of hazardous substances (e.g. cyanide, cadmium, mercury, EDTA, nonylphenolethoxylates, chlorinated organics)
- Substitution of processes generating hazardous substances wherever possible (e.g. cyanide oxidation with hypochlorite)
- Treatment of process baths using suitable processes in order to have the longest possible service life. Such processes include e.g. membrane filtration, ion exchange, electrolysis, thermal processes and evaporation
- Retention of bath ingredients by suitable means, such as transporting the goods in such a way that drag-out is minimized; splash guards or optimized bath composition
- Multiple use of counter-current rinse waters, at least three rinsing steps should be applied. Suitable techniques to keep more than 90% of the drag-out in a small volume for recovery/recycling.
- Separation of suitable non-ferrous metal waste water streams to carry out internal recycling (e.g. by electrolysis) or external recovery (e.g. by non-ferrous metal industry).

Waste water streams should be separated according to the kind of treatment necessary and in order to achieve a sludge composition such that the metals can be recovered.

Recommended maximum concentration in specific waste water streams:

Substance	Concentration (mg/l)
Cadmium	0.2
Mercury	0.05
Chromium (total)	0.7
Chromium (VI)	0.2
Copper	0.5
Lead	0.5
Nickel	1.0
Silver	0.2
Zinc	2.0
Unbound cyanide	0.2
Volatile organic halogens (VOX)	0.1

Cadmium and mercury have to be treated and monitored separately.

The limit values should be achieved without any kind of dilution before discharge.

Attention should also be paid to the fact that, in some cases, organic substances could be present in the waste water. Thus, if possible and considered suitable, such waste water from the electroplating industry should undergo biological treatment. This includes treatment in a municipal sewage treatment plant.

Reference

IPPC Reference Document on Best Available Techniques for the Surface Treatment of Metals and Plastics, August 2006

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