

“Capacity Building and Strengthening Institutional Arrangement”

Workshop: “Best Available Techniques (BAT)”

BAT on Painting industry

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1. Introduction

- Finishing is a process affecting both aesthetic and mechanical aspects of a product. A quality product not only looks good but has a protective and durable surface coating as well.
- Painting production is a chemical process involving a lot of natural and artificial substances, often with significant potential risk for health and safety and for the environment.
- Potential dangerous effluents emission in the various environmental matrices, significant water and energy consumption, bad and dangerous smell emissions are the most relevant environmental issues of the production cycle.
- Painting products are used in many civil and industrial applications, widely spreaded, thus resulting in a lot of diffuse sources of emissions, not easily to be monitored and controlled.

2. General information on paint industries

Painting products for finishing

- Varnishe (Coating): provides a transparent protective coating, without changing the color (paints without pigment).
- Paint: gives a colour to the surface, providing a protective coating as well.
- Enamel: is an especially hard, usually glossy, finish.

2. General information on paint industries

Painting products by function

- Primer: gives better adhesion of the final finish to the underlying substratum, increases paint durability, gives additional protection to the surface being painted (wash primer steel products, shop primer, antirust)
- Enamel: aesthetic function or coating into contact to atmosphere

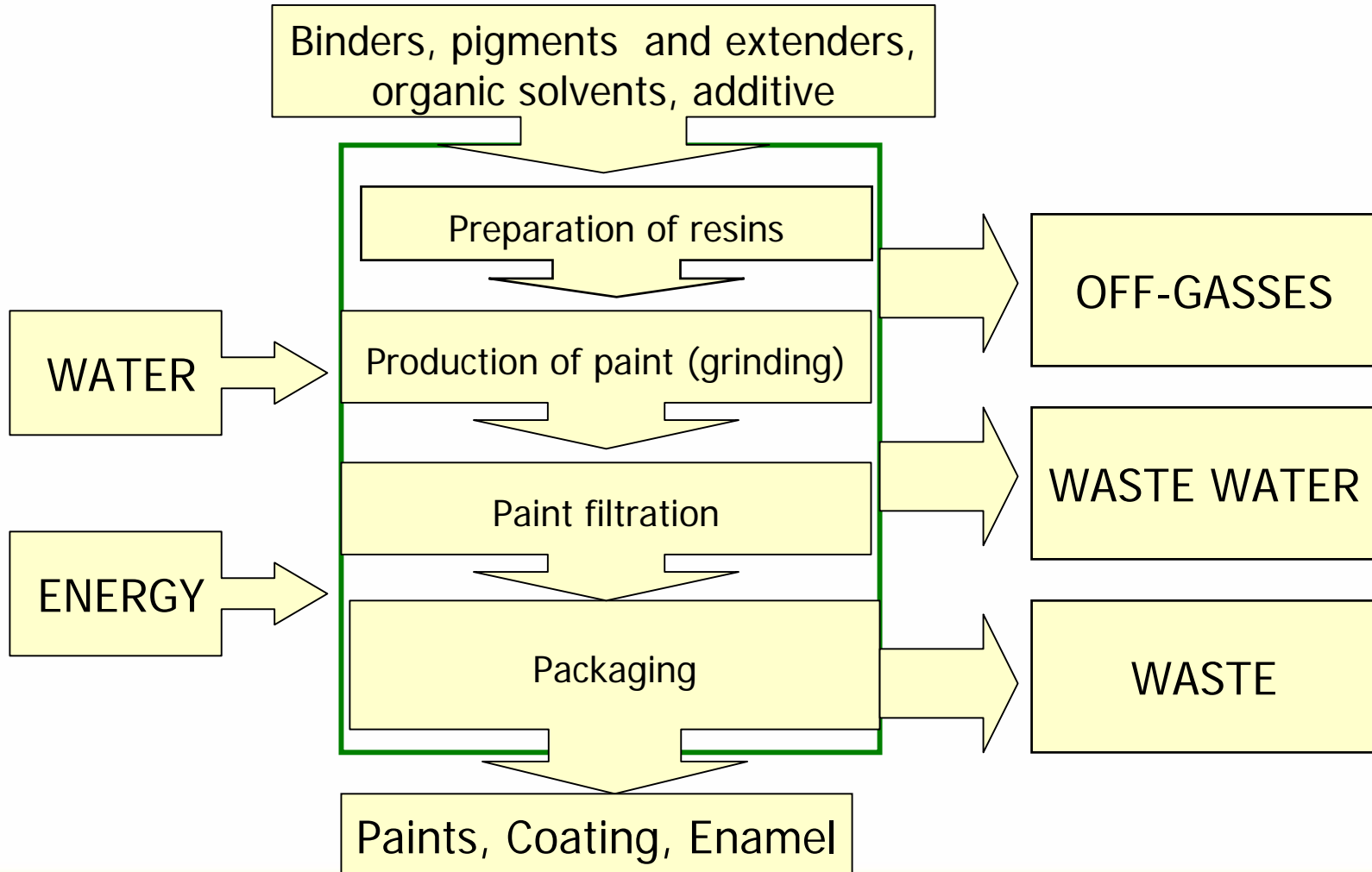
3. Raw materials

- **Binders**
 - Resins: alkyd (alcohol and acid or anhydride) and epoxy resins
 - Binders (polyurethane, vinyl, polyester, nitocellulose, silicon-based, phenolic, tarry or bituminous, chlorinated rubber-based)
 - Oil paints
- **Pigments and Extenders**
 - Inorganic or organic
 - Natural or synthetic
- **Organic solvents:** dissolvers and thinners
- **Additives**

To give specific structural or finishing properties

4. Operation phases of the production cycle

Production cycle for painting industry



4. Operating phases of the production cycle

- Preparation of resins
- Production of paint (grinding)
- Paint filtration
- Packaging

4. Operating phases of the production cycle

Preparation of resins

- Transport of raw materials from the storage tanks
- Dosage into reactors
- Reactions at controlled temperature by the use of agitators and process fluids
- Stripping of the solvent used in the reaction
- Storage or delivery of resins to the following phase

4. Operating phases of the production cycle

Production of paint (grinding)

- Selection, weighting and dispensing of compounds
- Mixing of resins, pigments and additives in mills

Ball Milling Mill (Traditional process)

- Selection of the ball material
- First mixing (all the pigment, part of the binder and of the solvent are mixed for 16-24 hour)
- Second mixing (addition of total binder and solvent – 30 minute)
- Third mixing (fine homogenization)

4. Operating phases of the production cycle

Production of paint (grinding)

Attritor Grinding Mill

The most important concept in the Attritor is that the power input is used directly for agitating the media to achieve grinding and is not used for rotating or vibrating a large, heavy tank in addition to the media.

BAT candidate – Advantages:

Energy saving; sharper particle size distribution;
easy disassembling and cleaning;
reduced wear on the media and other components, thus minimizing contamination.

4. Operating phases of the production cycle

Paint filtration

Removal of the impurities by filters:

- Cartridge filter (synthetic material cylinder at calibrated porosity)
- Bag filter (cloth filter for particle up to hundreded of micron)
- Upstream filter (metal or nylon cloth tightened between drilled rigid disks)

BAT candidate: washable and reusable, better efficiency, reduced waste volume

4. Operating phases of the production cycle

Packaging

Pumps and pipes are used to transfer the filtered product into the final packages.

Critical aspects:

- Potential risk of loss of paint from pipes and pumps;
- Package materials and type should be selected on the base of the final wasting phase.

5. Impact factors and pollutants

Impact factors

- A gaseous mixture is produced inside the mill, in the grinding phase, containing:
 - Particulate
 - Gaseous pollutants

- Different effluents and wastes are produced in the whole production cycle:
 - Liquid and gaseous effluents from production of resins and paints
 - Effluents from the paint filtration phase
 - Chemical waste from process loss and from filtering phases

5. Impact factors and pollutants

Main pollutants in the liquid effluents

- Metals in the pigments
- Organic Solvents
- Organic compounds (present in resins, in additives, in the organic pigments and in the raw materials)
- Other pollutants (silica, carbonates, sulphates etc.)
- Oils present in resins
- Suspended solid materials
- Alkaline pH

6. Primary and secondary prevention

Primary prevention

Limit, whenever possible, the amount of solvents in each phase of the production cycle.

Alternative materials and techniques:

- Termosetting powder (volatile components free)
- Hydrosoluble products (solvent made mainly by water)
- High solid solvent paints

BAT candidate: The philosophy behind the high solid product is that of substituting a traditional solvent product with a low environmental impact product, with a lower content of volatile organic compounds

6. Primary and secondary prevention

Secondary prevention. Gas effluent treatment

- Gas effluents are processed in order to remove:
 - Particulates
 - Wet cleaning facility
 - Dry filter
 - Centrifugal cleaning facility
 - Bag filter
 - Gas pollutants
 - Absorption systems
 - Adsorbing systems
 - Catalytic and thermal conversion

6. Primary and secondary prevention

Generic waste water treatment techniques

- Physical-chemical treatment systems
- Sludge treatment
- Anaerobic/aerobic treatment
- Drum and disc filtration
- Membrane filtration
- Advanced oxidation systems
- Equalisation tanks
- Biological excess sludge reduction

6. Primary and secondary prevention

Secondary prevention. Specific waste water treatments

- Degreasing (Oils and solvents removal)
- Solid or suspended material removal (Flocculation, floatation, coagulation and clarification)
- pH control (Neutralisation)
- Biological process (aerobic degradation, biological oxidation, etc.)
- Sludge treatment and storage, for final waste disposal

7. Water balance in the painting cycle

- **Consumption:**
 - Water used to reduce the volatile fraction of the raw materials
 - Water used to clean mills, mixers and containers
 - Water for gas stream purification
 - Water used as raw material (Hydrosoluble paints)
 - Service water (restoration, sanitary, washing and cleaning)

- **Waste water from:**
 - Resins production
 - Paints production
 - Gas stream treatment

8. Final remarks

- Also in absence of a comparative analysis of the existing techniques aimed to identify and to propose formal BATs, primary and secondary prevention analysis, as previously presented, could give a good starting point aimed to implement a valid environment safeguard program.
- Existing BREFs on chemical industry at EU level can give some general indication on effective measures to be implemented, mainly on filtration systems and on water and energy saving techniques.
- Uncontrolled dispersion of working residuals in the vast variety of civil and industrial applications of painting products remains one the most critical problems to be still faced.

9. Reference documents

- A specific BREF (Reference Document on Best Available Techniques) has not still been prepared. Some indications could be found only on pigments production, which are only one of the raw material used as input in the painting industry (Speciality Inorganic Chemicals).
<http://eippcb.jrc.es/pages/Fmembers.htm>
- Methodology for environmental analysys of production cycles – APAT 36/2006 (*Italian language*)
http://www.apat.gov.it/Media/cicli_produttivi/Avvio.htm
- Analysis of dangerous materials in Emilia Romagna Region (Cap. 3: Painting, Cap. 5 Plastics) ARPA Emilia Romagna, 2005 (*Italian language*)
- Athmospheric pollution reduction from industrial activities – Lombardia Region Official Bullettin, 2003 (*It. language*)