Reducing Emissions of Volatile Organic Compounds at a Paint Manufacturer

Project Title: Emission Reduction by Cleaner Technology Application in Coatings Production Unit of Chemolak
Leader: Chemolak, a.s., Smolenice, Slovak Republic
Partner: Synpo, a.s., Pardubice, Czech Republic; R&D
Location: Smolenice, Slovak Republic
Project Duration: January, 2000-January, 2001
EcoLinks Project Investment: Total Project Investment: $79,994; EcoLinks Grant Support: $49,584; Project Team Cost Share Contribution: $30,410.

Best Practice: Transferable Solution

This project is an EcoLinks Best Practice. It successfully integrated the technical, economic, legal and financial aspects of replacing volatile organic compound (VOC)-based paints with water-based polyurethane dispersions in the coatings production process. With the introduction of polyurethane technology, noxious organic solvents are reduced in the production process at Chemolak by 500 tons per year. Moreover, almost no volatile organic compounds (VOC) are emitted during the application of paints and varnishes by the end user. The market for polyurethane coatings is growing and there is a need for an environmental friendly technology to produce them in the region. The polyurethane waterborne dispersion manufacturing technology outlined by this project is highly transferable and could easily benefit other similar companies.

Project Summary

Traditional, solvent-based coating materials, such as paints and varnishes contain large amounts (50-70%) of volatile organic compounds. Volatile organic compounds are chemical substances that are toxic, carcinogenic and ozone forming. They emit noxious fumes that threaten the health of producers and users of the coatings. It destroys human lung tissue, ultimately impacting breathing capacity and weakening the whole immune system. VOC-based products degrade air quality and interrupt important ecological processes.

Yearly, 25,000 tons of VOC are released into the air in Slovakia and the reduction of VOC emissions is a high priority in Slovakia. This priority is articulated in the Slovak environmental policy, the National Program for VOC Emissions Reduction. One of the major targets of this program is the manufacturing of coating materials (e.g., paints, varnishes, thinners, resins, etc.). Coatings are one of the largest contributors to VOC emissions.

Chemolak is the biggest manufacturer of coatings in Slovakia. It produces approximately 20,000 tons of coatings per year. The company continuously upgrades its products to meet environmental standards. In 1998 the company implemented an Environmental Management System according to ISO 14001 standards. The traditional production of coatings at Chemolak, however, still emphasizes the use of VOC. To thrive in an international market that increasingly stresses safe and environmentally friendly products and to minimize the negative health and environmental consequences of VOC production and use, Chemolak needed to explore alternatives for producing quality coatings.

With the support of an EcoLinks grant, Chemolak and its project partner, SYNPO from the Czech Republic, collaborated to decrease Chemolak's use of VOC and generate coatings that are less harmful to the environment and less threatening to human health. To achieve this, they examined the possibilities for producing a water-based, polyurethane dispersion that would significantly reduce their reliance on VOC. A market study and an environmental assessment were conducted to determine the most suitable polyurethane dispersion. A legislative analysis was conducted to clarify the parameters of compliance for producing new water-based coatings. An implementation plan and an information sharing strategy were generated to commence production and marketing of the new product.

Project Activities

The main goal of this project was to prepare a plan for minimizing the use of harmful organic solvents in manufacturing paints and lacquers. In this effort, polyurethane is explored as an environmentally friendly alternative to the VOC-based products. This project involved several activities. They are outlined below.

1. Conducted a screening study

Action: An assessment of the current production facilities at Chemolak was conducted. The possibilities for modifying the reactor systems for the efficient production of polyurethane were identified. More specifically, suitable dispersion choices, manufacturing capacity for the selected dispersion, and environmental benefits were analyzed. A survey of the occupational health risk parameters was conducted. It was determined that with some extension of the temperature control and heat exchange systems, a polyurethane-based dispersion could be manufactured.

Product(s): 1) Survey of occupational health risk parameters 2) A technical report outlining the recommendations for changing current production facilities to focus on polyurethane (water-soluble) production.

2. Conducted a market study

Action: Data on the market aspects of polyurethane products were collected and analyzed. A literature review of the relevant issues on coatings was also prepared. Several markets for polyurethane dispersions were identified in the Slovak Republic, Czech Republic, and several countries in the European Union including Italy and Germany.

Product(s): 1) Data set on the market aspects of polyurethane products 2) Literature review on relevant coating issues 3) A report on the sale and marketing of polyurethane products in Central and Eastern Europe.

3. Surveyed environmental benefits

Action: The environmental aspects of manufacturing and using the new, water-based, polyurethane product were considered. For example, emission sources and levels under current and proposed manufacturing conditions were identified. Eco-toxicological testing was also conducted to determine the impacts of polyurethane production on water organisms. It was determined that the new technology is not toxic to water organisms. An evaluation of the emissions associated with the use of certain raw materials to produce polyurethane dispersions was conducted. The evaluation revealed that almost no emissions are generated in the production and application of polyurethane coatings. The new technology was then tested to assure product quality.

Product(s): 1) A technical report on the properties of raw materials and products involved in the manufacture of coatings 2) A presentation by Open Circle on the present state of emissions at Chemolak, Smolenice.

4. Reviewed VOC related legislation

Action: A thorough review of current and expected legislation regarding volatile organic compounds was conducted in sales-target countries. Legislative rules regarding material safety data sheets were also reviewed. Issues regarding new product categorization, labels, and packaging were considered with respect to Slovak legislation on chemical substances and European Union (EU) rules and directives. A literature search on additional relevant Slovak and EU legislation was conducted.

Product(s): 1) Documentation of the current and proposed environmental legislation on coating materials in the Slovak Republic, sales-target countries and the EU 2) Information documents on eco-labeling of new products, safety sheet templates setting standards for new European products, and the role of new technology in efforts to comply with the National Program of Volatile Non-Methane Organic Compound Emission Reduction.

5. Conducted an implementation study

Action: An implementation study was conducted involving several subprojects. An implementation plan was developed based on the results of the subprojects. The subprojects included:

1) a cost/benefit analysis;
2) an assessment of current environmental practices at Chemolak;
3) a study of new product compliance with the National Program for VOC Reduction;
4) a detailed proposal for manufacturing polyurethane dispersions including polyol preparation, polyurethane dispersion synthesis, quality control, and safety measures; and
5) raw materials toxicity assessments; and
6) a proposal to modify existing facilities.

Product(s): An implementation plan for reducing VOC and providing alternative coatings with fewer health and environmental consequences.

6. Implemented and reviewed new production efforts

Action: A manufacturing trial was conducted. This included purchasing raw materials, preparing equipment, conducting on-site measuring of emissions and wastewater contamination, and practicing operating procedures.

Product(s): A parquet varnish V1610 (Parketolak) using the new polyurethane dispersion introduced to production

7. Conducted public outreach campaign

Action: The project outcomes and contributions to environmental protection were published in several languages including Slovak, English, French and Russian. Leaflets on the new polyurethane dispersion were published in Slovak.

Product(s): 1) Publications on the project outcomes including an article on the project written by Open Circle for Enviromagazin published by the Slovak Environmental Protection Agency 2) Leaflets on the new polyurethane dispersion.

Project Benefits

This project provides capacity-building benefits and environmental and economic benefits. In summary, the project increased the implementation capacity for

manufacturing products that are less harmful to the environment, more marketable, and can be less costly to produce than alternative similar substances. A more detailed description of the project benefits is provided below.

Capacity Building Benefits

The methodology developed and applied in this project expanded expertise and experience in establishing an integrated vision for environmentally friendly product development. By reviewing the technical aspects, marketing issues, environmental impacts, and economic implications of product development Chemolak and other project participants gained knowledge and experience in an integrated approach to product development. In the process, they also gained additional experience in collaborative work across sectors (i.e., industry, consulting firms, and NGOs) to solve environmental problems.

Environmental Benefits

There are significant environmental benefits associated with producing and providing coatings with minimal to zero VOC content. These include:

- There is little to no emission of VOC during the production and use of polyurethane products. With the substitution of this environmental friendly technology, emissions are reduced to 10% of former levels at Chemolak. New coatings contain only up to two percent VOC. This reduces the health risks to employees, users and to the general environment. During the application of paints and varnishes, almost no VOC are emitted. Chemolak will manufacture over 1000t of the new product yearly, avoiding the emission of 500 tons of VOC per year.
- Polyurethane products do not harm aquatic organisms. This alleviates some of the environmental impacts of coatings production and of the disposal of paints and lacquers.
- The new dispersion is very low in VOC concentrations as it contains only 3% of acetone.
- There are no fire risks associated with water-based dispersions. This reduces further impacts on human health and the environment.

Economic Benefits

The major economic benefits are the following:

- The polyurethane product is 5% less expensive than other currently available similar products.
- A polyurethane dispersion produces quality varnish products. For example, they bind well to wood and metal surfaces and are highly resistant to erosion. This makes it appealing in a local and an international market setting.
- Market potential is increased. Polyurethane dispersions can be used for the production of in-house coatings as well as for sales to other coating manufacturers. This increases the potential consumer sales base.
- Chemolak is prepared to comply with new environmental legislation. By reducing VOC emissions now, Chemolak avoids having to make drastic and

perhaps more costly changes later to comply with emerging environmental legislation.

The financial analysis of the investment project revealed the following:

Necessary investment outlays - $ 80,000
Simple Payback Time – 3 years
Net Present Value (rate of return 11%) - $ 520,000

Lessons Learned

The following lessons were learned during this project:

- Efficient cooperation and active involvement of all the project parties are especially important in contract relations that require collaborative implementation.

- The involvement of a non-governmental organization (in this case, Open Circle NGO) helps with the promotion of new environmentally sound technologies.

Contact Information

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