RESITRIX AND THE ENVIRONMENT

CREM
Consultancy and Research for Environmental Management
Spuistraat 104d
1012 VA Amsterdam
Phone: +31 20 6274962
Fax: +31 20 6266539

Amsterdam, December 1996

Resitrix and the Environment

1. Introduction

Environmental considerations are playing an increasingly important part in the choice of products and materials in the construction sector. In the case of roofing systems for flat roofs, this concerns mainly materials based on bitumen, polyvinyl-chloride (PVC) and EPDM (synthetic rubber) such as Resitrix.
Resitrix is made up of different layers. The sub-layer is composed of SBS-modified bitumen. The top layer is EPDM, covered on both sides with a coating of thermo-plastic elastomer (TPE-coating). The TPE-coating makes for a good adhesion with the SBS-bitumen, also allowing for hot welding of the overlapping sections.

In order to get a clearer picture of the environmental aspects of Resitrix, Phoenix AG commissioned the Amsterdam based environmental consultancy firm CREM to perform a quantitative life-cycle assessment (LCA). The following LCA distinguishes between three different techniques of application:

- Loose laid with ballast
- Mechanical fixing systems
- Bounded systems

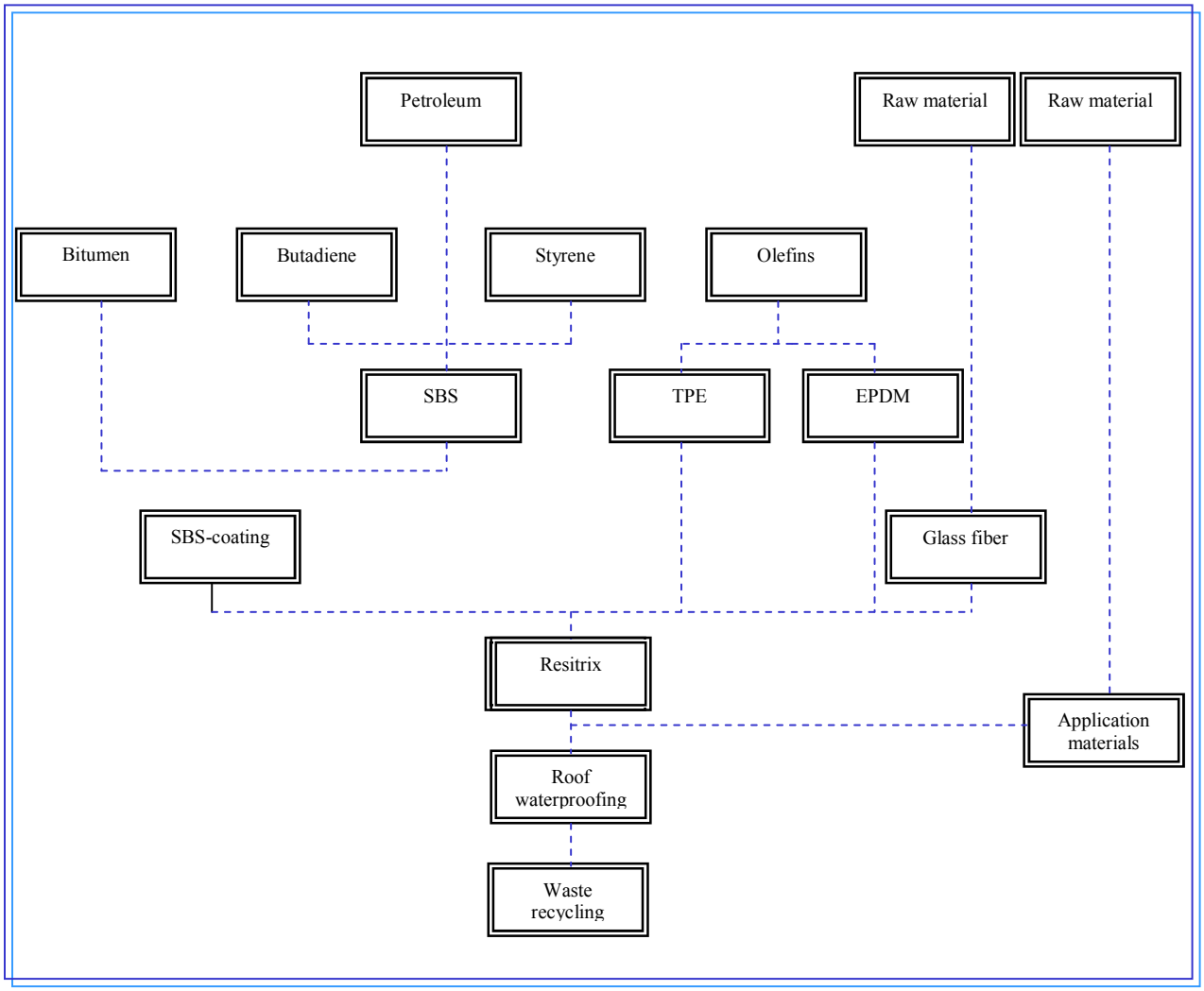
The main objective of the LCA was to clarify whether the application of Resitrix on flat roofs is an environmentally sound method. Additionally, the LCA is an instrument for further environmentally friendly product development. The results of a LCA indicate, which adaptations produce the highest environmental gains. The following LCA compared Resitrix to other current roofing systems based on bitumen and PVC.

The following publication contains a summary of the primary results to the CREM-report: ‘Environmental effects of roofing systems for flat roofs’.

2. What is a LCA?

The LCA of a product determines all potential environmental effects of the entire production chain (‘from the cradle to the grave’). Figure 1 represents the global product life cycle for Resitrix.

Figure 1. Global product life cycle for Resitrix



The underlying LCA-method in this study was devised by the Centrum van Milieukunde (CML – Centre of Environmental Science) in Leiden, the Netherlands. Furthermore, it attempted to follow the guidelines of the concept of the ISO-norm 14040 for LCAs and of the SETAC (Society of Environmental Toxicology and Chemistry).

The point of departure in a LCA is a functional product unit. The most relevant function of Resitrix is, of course, the covering of a certain amount of square meters of flat roof. Apart from the quantity of material per square meter, durability, as well as the cost of upkeep of the product, are relevant to the functional unit. A short life span always goes hand in hand with early

replacement and as a consequence with higher material consumption. The environmental impact is therefore established for a standard given time.

The survey uses the following functional entity:

The covering of a flat roof with a surface of 1000 square meters for a period of fifty years.

The choice for sub-layer was an isolation layer of mineral wool, coated with bitumen depending on usage. Additional provisions for rainwater drainage or rain gutter ware not included in the study.

3. What is the environmental impact?

The survey scrutinized all relevant processes in the life circle of Resitrix for their environmental effects, including transport. The CREM Report 'The Environmental Impact of Roofing Materials for Flat Roofs' also contains a detailed justification of underlying parameters.

Resitrix was tested for the following effects on the environment:

***Depletion of raw materials**:* use of finite resources.

Greenhouse effect: emissions that contribute to global warming.

***Acidification**:* increased acidity, generated by the release of sulphur dioxides, nitrogen oxide and ammonia into the atmosphere.

***Nutrient pollution**:* excessive enrichment of water and soil with mineral nutrients, as phosphates and nitrates.

***Smog**:* emissions of volatile hydrocarbons, which generate smog.

***Aquatic eco-toxicity**:* emission of environmentally harmful substances in water.

***Human toxicity**:* emission of substances hazardous to man.

***Waste**:* dumped waste as an indication of pressure on public space.

***Energy consumption**:* Is the cause of major environmental problems (amongst others, the greenhouse effect, acidification), which are as a consequence interconnected.

A number of effects on the environment were not taken into account. Resitrix has, for instance, no implications for the thinning of he ozone layer, because

Resitrix does not release any CFCs or HCFCs during the life cycle. Also other environmental effects, such as waste heat, noise, pollution, bad odors, or soil pollution have no relevance with regard to Resitrix or can not be quantified sufficiently.

Thus far, there is no generally accepted method to add up all the different environmental effects. As a result, it is not possible to put the environmental impact of Resitrix into a single figure. Even if a product does not get the best results with respect to all environmental effects, it is, from an ecological point of view, not possible to single out one product as the best.

A separate environmental analysis was done for the three different applications systems for roof covering for Resitrix.

4. Loose laid with ballast

The sheets are loosely fitted on the roof and the overlap is hot hair welded and then ballasted with gravel and / or stone tiles. On average, the placement of Resitrix calls for the use of 3.88 kg sheets (1.08 m²) and about 66 kgs gravel on one square meter of flat roof. Based on the material features and practical experience with Resitrix, the expected life span of the roof covering system is 50 years.

The energy consumption during the entire life cycle gives an important indication of the total environmental impact, because many environmental effects are strongly related to the energy consumption. The greenhouse effect, acidification, nutrient pollution, smog and human toxicity are on the whole determined by the energy consumption.

The total energy consumption of Resitrix is relatively low with regard to this mode of application method. Loose laid waterproofing of the average home with a flat roof of 45m² with Resitrix demands almost 4.7 GJ during the entire life cycle. This compares to the 13 % of the energy that is used annually for the heating of well-insulated houses.
The production of material, as well as the transport requires energy consumption. The contribution of gravel to the total energy consumption in the life cycle of Resitrix seems to be considerable: more than 25 %.

Apart from the exploitation of petroleum and natural gas, the exploitation of Zinc contributes to the problem of depletion of raw materials (Zinc is used as a stabilizer and the global supply is limited). Emissions of hydrocarbons and oil in water are important contributors to eco-toxicity - especially severe in the case of exploitation and refining of petroleum. Most of the waste is caused by the ballasting material.

Ballasted roofing with Resitrix, is, from an environmental point of view, superior to other current systems. Especially when the longer expected life span of Resitrix is taken into account. But even if the other roof covering systems had the same life span, Resitrix holds more than equal to the other systems from an environmental point of view. Therefore, the Resitrix system is an environmentally sound choice.

5. Mechanically attached systems

This method of application is quite common. Galvanized steel pressure distribution plates hold the sheets in place by means of screws, in order to prevent the tearing of the roof sheets. The placement of the roof sheets requires 4.06 kg (1.13 m²) Resitrix per m². It also requires about 42 grams galvanized steel screws and 119 grams pressure-distribution plates per m². Hot welding fuses the overlap of the roofing sheet. The life span of the roof covering system is expected to be around 40 years.

For an average house with a flat roof of 45m² the mechanical attachment of Resitrix requires almost 5.4 GJ, during the entire life cycle. This compares to 15 % of the energy that is used annually for the heating of most well insulated houses. The screws and washer plates account for 14 % of the total energy consumption in the life cycle of Resitrix. The low energy consumption limits the impact on the environment, with regard to energy related problems, as greenhouse effect and acidification.

The attached system has the same effect on depletion and eco-toxicity as the ballasted roofing system. Scarce Zinc, used as a stabilizer, contributes considerably to the problem of resource depletion. The exploitation and refining of petroleum is the main source of the emissions into water. At the end of the cycle, the weight of the roof sheets determines the amount of waste.

Mechanically attached roofing with Resitrix, is, from an environmental point of view, superior to other current systems. Especially when the longer expected life span of Resitrix is taken into account. But even if the other roof covering systems had the same life span, Resitrix holds more than equal to the other systems from an environmental point of view. Therefore, the Resitrix system is an environmentally sound choice.

6. Fully bounded system

A new development in self-adhesive sheets, like Resitrix, is the use of solvent free primer (partial adhesion). The glue is applied point by point on the roofing sheets. Hot welding connects the overlap. This placement requires 3.88 Kg

Resitrix per sqm flat roof, 1.0 kg of bitumen as a sub-layer and 0.25kg solvent free primer

The expected life span by partially bounding is around 40 years.

Total energy consumption of Resitrix is relatively low with regard to this way of application. The adhered system covering of the average home with a flat roof of 45m² with Resitrix demands almost 4.8 GJ during the entire life cycle. This compares to 14 % of the energy that is used annually for the heating of most well insulated houses. The bitumen substrate and the primer are responsible for 9 % of the total energy consumption of Resitrix.

The adhered system has the same effect on depletion, eco-toxicity and waste as the mechanical roofing system.

Because of its long life span, partial adhesion of Resitrix is an environmentally sound choice. Even if the other roof covering systems had the same life span, Resitrix holds more than equal to the other systems from an environmental point of view.

7. Life expectancy

From the environmental perspective, the EPDM-products are superior to the other roof covering materials in terms of life expectancy. This becomes apparent from the prior paragraphs. Assuming an equivalent life span, there are no clear differences regarding the other environmental implications.

Proceeding from practical experience, there are indeed strong indications of a longer life expectancy of EPDM roof covering in comparison with PVC and bituminous materials. However, this has not yet been proven conclusively by scientific research. In order to settle this question Phoenix AG has already started with product sustainability research.

8. Other environmental activities of Phoenix

With an eye on the future, Phoenix AG is looking for other opportunities to minimize the environmental effects of Resitrix further. The energy use in the production process holds the best starting points for improvements. They are also searching for an alternative for Zinc, which is currently is used as a stabilizer in EPDM.

The LCA performed by CREM assumed that all material would be land-filled at the end of the products life cycle. If materials were instead recycled, the environmental pressure would be reduced substantially.

With that objective in mind, Phoenix has committed itself to recycle the old Resitrix roof sheets. It is now possible to use finely ground Resitrix, reusing the elastomers as well as its bitumen components without complimentary treatments, for the production of 'new' Resitrix roof covering. In conjunction with the recycling possibilities of spent Resitrix, the choice of the placement method will determine the costs and the benefits even more profoundly. Recycling of ballasted, or mechanically installed roof covering is considerably easier than the recycling of fully adhered systems.

9. Conclusions

Resitrix is an environmentally sound choice for the covering of flat roofs. This holds true for all three modes of application, if we assume that the competing materials can be expected to have about the same durability. If we assume a longer life cycle for Resitrix, which is highly probable, this product scores more points on most environmental aspects than competing materials.

The continuing environmental efforts of Phoenix AG, e.g. in the field of recycling, will reduce the environmental impacts of Resitrix even further.