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Multilayer Coatings Preventing Storage Tanks from Leaking Petroleum Products to the Environment

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The solution presents additional walls preventing storage petrol tanks from leaking petroleum products into the ground and the surface water. The additional walls consist of a two-layer coating made of a double fleece material that is stiffened by the hardening resins and outer laminate layer made of the resin reinforced by the glass fibre. The leakage monitoring takes place in the coating by using permanent monitoring and leakage signalling installation by both dry and wet systems. The above-presented solution can be widely used in military units – especially in tanks installed earlier in former fuel stations.

Keywords: fuel tanks; environment; coating; fleece material; polyester resin

According to national and international regulations petrol tanks – that have already been exploited – must have additional walls preventing diffusion of petroleum products into the ground and the surface water. [1]

A polyester resin can be a component of layer coating preventing storage tank from leaking petroleum products to the environment. It has good strength parameters (see Table 1)

TABLE I Characteristics of the polyester resin [2]

1. Basic data		
Volatile matter content 1g, 125°C, 1h)	54 ÷ 58	[%]
Absolute viscosity at 23° C	ca. 3000	[mPa. s]
Acidity	max. 8	[mg KOH/g]
Gelation time at 20° C	ca. 40	[min]
Density at 20° C	ca. 1,06	[g/ml]
Flash - point	ca. 34	[°C]
2. Data on uncured polymerising resins		
Bending strength	90	[N/mm^2]
Modulus of elasticity	4000	[N/mm^2]
Tensile strength	2	[%]
Shear strength	90	[N/mm^2]
Barcol hardness Hc 60	40	-
Impact strength	8	[kJ/m^2]
Notched impact strength	1	[kJ/m^2]
Martens deflection temperature	105	[°C]
Density at 20° C	ca. 1,18	[g/ml]
Dielectric loss factor	0.03	-
Surface resistance	10^{13}	[Ω]
Internal resistance	10^{15}	[Ω]
3. Data on polymerising resins reinforced by glass fibre		
Glass contents	30 – 60	[%]
Bending strength	160 - 400	[N/mm^2]
Modulus of elasticity	9000 - 21000	[N/mm^2]
Tensile strength	110 - 310	[%]
Shear strength	180 - 235	[N/mm^2]
Elongation	2	[%]
Impact strength	100 - 200	[kJ/m^2]

According to the presented solution, there are following components of a layer coating preventing storage tank from diffusing petroleum products to the environment: [3]

- a two-layer coating consisting of the double fleece material that is stiffened by the hardening resins forming the tapes that are put one by one. This coating is put on the inner surface of the fuel tank in the radial or longitudinal direction;
- the other is an outer laminate layer made of glass fibre reinforced resin forming solid and strong coating that resist petroleum products on the whole inner surface of the fuel tank.

The components of the layer coating preventing storage tank from leaking petroleum products to the environment can be fixed to tank's wall in two variants. Figure 1 illustrates variant that consist in fixing on the outer surface of the fuel tank's wall.

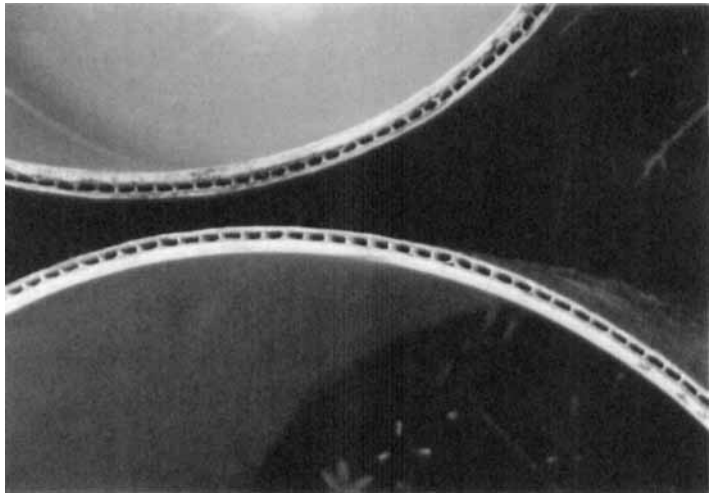

FIGURE 1 The layer coating fixed on the outer surface of the tank's wall.

In order to make the two-layer coating capable of withstanding the probable pressure in the inner or outer side of the tank's wall – in case of a leakage, it must be resistant to compression and cutting. On the other hand, the resistance of the coating to cutting can not be too high to prevent not full clinging from the tank's wall.

Both the top and the bottom coatings and the fleece threads are made of fibre that is highly resistant (for example glass fibre, carbon fibre or the aramid fibre). The structure of the material is made by intersected threads of weft and warp. The fleece threads, however, are fastened on the top and the bottom coating in such a way that they form the bands containing a few (5 to 7) threads of the weft. Two layers of the fleece material are connected together by stiffing ribs made from the fleece threads that keep the layers in a distance from each other. Stiffening ribs of the coating form the linear spreading out barriers, whose highs are small (2.5 to 3.5 mm). These barriers are made from a large number of fleece threads that are juxtaposed and saturated by the hardening resins. Every barrier gives the shear strength of the flat double fleece material and also makes the permeability possible, which is necessary in the detection of leakage that are kept in the tanks of the petroleum products.

The stiffening ribs set in the cured resins are usually closed is this way. The top and the bottom coatings form two stiffened walls; there is a space between them which is only half – filled by the stiffened barriers – besides it it's rather empty. Empty channel spaces can be limited to the area of the seam or the joint – and be interconnected in this place. In this case even when the barriers are well-closed, different empty channel spaces are bound together, which makes the liquid monitoring spread out over an all layer area. If the barriers are not fully closed through the resin saturation, then the empty spaces can be bound together also over the barriers.

To saturate the double fabric a reactive hardening resins is used – for example unsaturated polyesters, epoxides, vinylesters, phenols, polyurethanes,

silicones, polyimides. Also the resins hardened by ultraviolet radiation can be used here.

The fixing of the double fleece material on the tank's wall is done by using a shrinkable resin that can be reinforced by glass fibre and strengthen the double material on each side as a laminate.

The advantage of this type of the fuel tank walls with the multiplied coating is their better resistance to the corrosion, but also there is a possibility of leakage monitoring in the two-layer coating. This structure enables to prevent the pollution of the environment.

The leakage monitoring takes place in the coating by using permanent monitoring and leakage signalling installation by both dry and wet systems.

A leak indicator can be used to signal a fuel leakage. It keeps constant positive gauge pressure in the intershell space. The leak of the tank causes pressure drop, which is automatically signalised by light or a sound signal. To signal the leakage in the wet system, however, one can use an electronic effluent detector, which consists of signalling device, detection liquid tank, and sounder.

The above presented solution can be widely used in military units, especially in tanks installed earlier in former fuel stations.

The installation of the whole second tank's wall without necessity of doing some construction works or changing tanks appears to be the advantage of the solution. Such works or changes would be very or top expensive for the Polish Army that has already possessed a large number of single-wall tanks.

References

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