

## Bitumen adhesive



Bitumen, *bituminis* is a very ancient product. The Egyptians, the Greek and the Romans were already acquainted with it. The Romans called it *earthpitch*. Its natural source was *Ragusa* on Sicily, where it was found in rock-formations, which contained about 14% of *bituminis*. They were using it as an adhesive for wood and glass, as well as a caulk sealant to make their boats watertight. There were other places in Europe where people discovered this sticky, dark-brown, tough and very useful product, as Val de Traver, Neuchâtel and Bentheim. In Europe *bitumen* is a common term. When we are talking about asphalt, we actually mean bitumen mixed with fillers, pebbles and flintstones to pave roads. While in the U.S. bitumen is called asphalt. A very famous natural source is the *Asphalt Lake* in Trinidad. The product found there contains about 39% of bitumen.

While the request for bitumen was continuously increasing, the industry developed a synthetic alternative. Nowadays bitumen is made from crude oil. In a few words: separation sand and water and distilling off all the low molecular products of crude oil gives a residue which is also called bitumen. It is a mixture of heavy carbonhydrogens with molecular weight of 1000 to 10.000. Bitumen consists of an oily phase, the maltenes, and a dispersed phase of asphaltenes. These phases can be separated by extraction with selected solvents. The consistency may vary from syrup-viscous to a hard brittle product. This product becomes low viscous at higher temperatures. Bitumen is thermoplastic by nature. It has a darkbrown colour. It is poisonless, tasteless and it has a very soft non-disagreeable smell. It is very resistant to inorganic bases and acids. The Water Vapour Transmission Rate (WVTR) and the Water Transmission Rate are very low.

Because of its viscosity elastic properties bitumen happens to flow under certain conditions. The amount of flow depends of the type of bitumen, of the temperature, the time, the layer thickness and of the force being applied. There are very many types of bitumen: like penetration bitumen, hard and blown bitumen and modified bitumen. The latter are mixtures of thermoplastics with penetration bitumen.

Bitumen is applied in various ways as in:

- paving
- hydraulic engineering, for example in dike and sea-bottom coverings and its reinforcement
- adhesives in building and roof covering materials
- sealants
- covering for pipelines and storage tanks
- protective coatings for steel and concrete against seawater
- impregnating ropes, non-wovens and wood
- it has found its way in electrical industry and it is used for many other applications

As already mentioned before, bitumen has some disadvantages:

- it is black, which makes it unsuitable for many applications
- it is high viscous or hard, so it needs energy before being applied
- it has cold flow properties, so modifications are necessary when a constant load is present
- it is brittle at low temperatures (hard-bitumen)
- it is fluid or soft at higher temperatures (penetration bitumen)
- it is not resistant to solvents, oils and greases

But bitumen has so many advantageous properties, which is in the favour of this product. Therefore, it is a very attractive base material for industrial applications.

- it is low cost, that makes it an economically interesting base material
- it has bonding properties, so it is an interesting product for adhesives
- it is very resistant to water and organic chemicals it is attractive for coatings and adhesives
- while its WVTR is low, it prevents steel from corrosion and concrete from degradation

The cold flow, the flow and brittleness at low temperature are the most unpleasant performance properties of bitumen. For modern adhesive applications, where more and more low temperature flexibility and high temperature resistance are required, bitumen is unsuitable. The need for high performance adhesives depends of the application. We all know that the aircraft industry has higher requirements than the building industry. It is clear that this building industry needs a lot of adhesives. The adhesives to be used should have the following properties:

List of demands for building industry adhesives :

- a. low cost
- b. easy-to-handle
- c. independence of weather during application
- d. colour: preferably black for roofing and cellars
- e. temperature resistant from – 20 up to at least 80°C
- f. for moving connections flexibility is required
- g. impermeable and resistant to water and water vapour
- h. long lasting: at least 30 years
- i. resistant to acidic rain and basic leakwater
- j. it should not affect the environment

Now, it is so, that bitumen matches all these properties except e. and f. So if these two parameters can be achieved by modification of bitumen, the result will be a good adhesive for building application.

There are three ways to improve the cohesive properties of bitumen:

1. combination with thermosetting like PUR
2. incorporation of a thermoplastic material like APP, EVA, SBR, nitril or butyl rubber or combinations here of
3. incorporation of a low molecular weight substance, which is subsequently reacted, so a matrix of branched polymers with bitumen is achieved.

Sub 1 Although very strong adhesives can be obtained, non is useful as a hotmelt. Because these are thermosetting, we leave this subject.

Sub 2 In this way pure thermoplastic compounds are obtained. High shear rates are necessary to get constant quality products. These products are very suitable as compounds to make pressure sensitive tape for the automotive and the building industry. As hotmelts they are only applicable by extruders.

Sub 3 Hardcast worked out recipes in which low molecular weight thermoplastic materials are mixed with bitumen. The next step is slightly crosslinking the thermoplastic material whereas some of the bitumen is reacted with. The product obtained is called Hardcast Bitumentape.

Since 1982 Hardcast produces Bitumentapes. The adhesive is the base material for all related

products. Originally Hardcast started with Bitumentape as a hotmelt in tapeform.

Projects accomplished more than 10 years ago are still watertight.

Bitumentape is used now as a water barrier and overlap tape-sealant in ponds, basins, car grave yards, bathrooms, building industry etc. The adhesion increase over time and the elasticity of the adhesive is more than 200%.

Other results of our testing :

*(Bitumentape double sided, 1,4mm thickness)*

Water Vapour Transmission Rate ASTM E 96-53T	0.29grs/m <sup>2</sup> /24 hrs
Water Transmission Rate NEN 1013	no water transmitted
Temperature-resistance	-20 to 70°C
Resistance to acidic and basic influences	after 1 year immersion no change
Resistance to manure	after 1 year immersion no change

Comparison of resistance of Hardcast bitumentape vs other types of sealants :

	<i>Bitumen adhesive</i>	<i>PUR</i>	<i>Polysulphides</i>	<i>Silicones</i>
UV radiation	+	+	+	++
Water	++	+	++	++
Acids	++	-	+	++
Bases	++	0	+	+
Solvents	-	0	+	-
Manure	++	-	-	-

On the long term it was the Bitumentape that showed out to be the only material resistant to manure. So it is an excellent product for agricultural applications such as dungpits and manure containers.

Hardcast produces several types of Bitumentape all with different backings. Most of them are used in building industry for sealing, reparation and renovation.

Several types Bitumentape :

<i>Type</i>	<i>Thickness in mm</i>	<i>Backing</i>	<i>carrier</i>
DSF7910	1.0 *		glassfiber
AAA7910	1.0 *	aluminium foil	
VPB7914	1.2	laminated PE-foil	
PWA7908	0.8	PP non woven	
ALP7910	1.0 *	Alu-PE laminate	

- also available in 1.4mm

#### Safety aspects

Bitumen and bitumen compounds are generally speaking: Non toxic, non carcinogeneous and they do not affect the environment. However, one should take care, not to allow more than 5 mg of an aerosol of bituminous products per m<sup>3</sup> of air, especially when one is spraying.

So finally it will be clear that bitumen, already used for over ages, has very good properties for applications in building industry. Modification of bitumen with reacted thermoplastics results in products suitable as pressure sensitive adhesives.

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