

Sealing Systems Based on Bitumen Emulsion Enhanced by Polymers, Applied by Brush Roller or Spray, Compared to Bitumen Sheets

By: Eitan Haviv, Eng., Deputy General Manager, Development and Marketing, **Bitum LTD, Israel.**

The share of sealing systems applied by cold spray and by brush or roller out of all the popular sealing systems is increasing steadily in recent years. For example, in the U.S.A., these systems captured 5% of the entire volume of BUR bitumen and polymer enhanced systems for many years, but in recent years, these systems doubled their market share and reached 10% of the application volume of bitumen systems, which keeps increasing steadily. This data is quoted from a paper authored by John A, D'annunzio, published at the Conference on Sealing held on September 2002, in the U.S.A.

Bitumen systems, applied by spray and by brush or roller, mainly characterized by materials containing bitumen enhanced with polymers, are mostly used to seal cellars and paved surfaces. These systems are divided into the following material families:

1. Liquid two-component systems (such as **Flexigum**) based on bitumen emulsions enhanced with polymers. In these systems, the sealant and the coagulant-hardening agent are sprayed simultaneously through two nozzles of the spray gun. Both materials are joined in the air. The bitumen emulsion is quickly broken and solid particles of the sealant settle on the surface, discharging the major quantity of water, present in the particles. After a curing process of several days, an impermeable, flexible and seamless membrane is created over the surface, typically 4-5mm thick.



2. One component paste systems (e.g., **Mastigum**) are also based on bitumen emulsion enhanced by polymers. These systems are intended for either airless spraying or application. The membrane is created through a physical process of curing the coat thereby yielding a sealing membrane. The composition of the components in these systems must be performed in a way that ensures prevention of a re-emulsification process after prolonged soaking in water. These systems are characterized by a thinner membrane (2-2.5mm), required by the need to enable curing of the entire coat, up to its inner layer, prior to covering with soil, concrete or paving.



When we set out to define the cases where these sprayed or applied systems should be preferred over using torched bitumen membranes, we should relate to the following:

1. **The expected adhesion rate of the sealing system to the surface:** In horizontal surfaces, e.g., roofs and cellar floors, correct application may yield a high adhesion rate (over 80%) of torched bitumen sheets. It is highly recommended to increase the adhesion to the surface rate by applying warm bitumen, enhanced with polymers (SBS) as a primer coat over the concrete substrate, prior to welding the bitumen membranes. This combination will yield two important advantages:
 - 1.1 Application of a flexible, seamless sealant coat on the surface, concurrently smoothing the surface in preparation for laying the bitumen membranes.
 - 1.2 Perfect or nearly perfect adhesion of the sheets to the surface.

Consequently, in horizontal surface which are not very small or crowded with facilities and penetrating pipes, it is clearly preferable to use bitumen membrane as the primary sealing coat.

On the other hand, in vertical surfaces, the existing adhesion rate is usually very low, about

only. Correct smoothing of the surface and torching the membranes from the bottom upwards (which is not performed usually) may increase the adhesion rate and reach 60-70%. This partial adhesion may turn a local failure into a general failure, due to water migration through the spaces between the membranes to the cellar wall, until the water penetrates through a weak spot.

Consequently, it is preferable in these cases to use sprayed or brush applied sealants. Application of these materials provides the ability to reach a very high adhesion rate of nearly 100%.

2. Expected Cracking of the Structure

The expected width of the future cracks that may appear in the structure during or after the application of the sealing system, combined with the water pressure which the sealing system will be expected to resist are decisive factors, directly affecting the selection of the system.

Bitumen sheets, especially when applied in two layers, may bridge over rather wide cracks without affecting the sealing capacity, under water pressure.

Upon considering the application of sealants by spray or brush, one must bear in mind three factors which affect the ability of these products to bridge gaps under water pressure:

2.1 Membrane tearing strength compared to adhesion to the substrate strength.

2.2 Flexibility of the material.

2.3 Thickness of the sealant coat.

Bitumen sealants based on bitumen emulsions enhanced with polymers have an excellent flexibility (over 1200% elongation). Adhesion to the substrate strength of these products is usually higher than the tensile strength.

Therefore the thickness of the sealing membrane is significant when defining a sealing system based on products applied by spray or brush.

In large structures, the expected cracking rate and water pressures are higher. In these structures it is recommended to apply two component systems, based on bitumen emulsions enhanced with polymers (e.g., Flexigum). In these systems, the bitumen emulsion is broken during the spraying process, 80-90% of the water is discharged from the material during the first hours following the application. The remaining water evaporates after 2-3 days (mainly in application over vertical surfaces) yielding a tight sealing of the membrane.

These systems can be usually applied in a thickness of 4-5mm, capable of bridging up to 2.0mm wide cracks which may appear in cellar walls after the application of the sealing system, while resisting water pressure of up to 1 atmosphere (10 m head of water). If so required by the conditions, the thickness of the system may be increased to 6mm.

3. The Geometry of the Surface that requires Sealing

When the surface is not level and presents a complex geometry, or contains numerous facilities and penetrating pipes, it is best to use applied and sprayed sealing systems.

It is most difficult to fit bitumen sheets to spatial surfaces. Required surface preparation costs are very high, the application is costly and the success prospects of the system are rather low, due to the meticulous execution required at each stage. The same is true for retaining walls made of piles or for cellar floor with numerous penetrating piles.

4. Sealing System Application Schedule

When a shorter schedule is required for applying a sealing system on elements, especially underground sections, such as cellar walls, without waiting two weeks for the concrete to cure, you may spray a water based sealing system (especially a two component system) which can bond with the concrete before it is completely cured.

Yet, considerations must include the required curing time of the sprayed sealing system (usually 4-5 days) in the time allocated to complete the sealing system.

5. Dimensions of the Elements that require Sealing

When the dimensions of the elements that require sealing are especially small, e.g., shower floors, or small balconies, the application of bitumen membranes turns into a complex, prolonged, costly and seams rich operation, with reduced reliability.

In such elements, it is preferable to use paste-like products, based on bitumen emulsion, enhanced with polymers (e.g., Mastigum).

6. Application of a Sealing System where Fire Lighting is Prohibited

Even in these cases, sprayed, water based sealing systems have a clear advantage, since these are completely safe for application in such sensitive areas.

In conclusion, cold sealing systems applied by brush, roller or spray are steadily developing in recent years and the accumulated knowledge and application experience yield satisfactory results at a relatively high reliability rate. Consequently, these systems capture a noticeable place in the world sealing market.