A new generation of adhesion promoters that combines superior coating and exceptional workability with immediate commercial saving.
The life of an asphalt pavement depends basically on the adhesion between the bitumen and the aggregates, and it is the result of the ability of the bitumen to resist to static and dynamic stresses caused by traffic and by the action of the atmospheric agents such as air, light and water. Traffic and atmospheric agents, however, will influence the durability of the asphalt, which, with the passing of time, undergoes physical and chemical transformations, deformations and cracking.

95% of a mixed asphalt for a road surface consists of a mixture of "stone aggregates" with a specific granulometric curve. The choice of aggregates depends on the technical requirements of the final asphalt layer. Chemically they can be “acidic”, in which case they have the surface characteristic to attract negative charges or “alkaline”, in which case they will attract positive charges. The “acid” aggregates are characterised by a high content of silica, while the “basic” ones contain carbonates.

The bitumen is on average 5%, by weight, of a mixed asphalt. Bitumen is used in many fields of the road construction industry thanks to its adhesive properties. Bitumen is a complex mix of chemical substances, characterised by the presence of molecules with low polarity. The adhesive properties of the bitumen are strictly connected to the presence of acid groups, for this a bitumen with high acidity have better adhesion than a neutral bitumen.
The bitumen has a low chemical affinity with the aggregates, while the aggregates have a high affinity with water. For this reason, the adhesion of the bitumen can be seriously compromised by the presence of water on the surface of the aggregate. The presence of water at the interface between bitumen and aggregate is the primary cause of moisture-induced damage and of the premature failure of road pavements.

The adhesion between bitumen and aggregates represents the critical point of the entire construction of a road paving process. It is essentially characterized by two phases:

1. **Wetting**
   
   This represents the ability of bitumen to fully cover the aggregates. Bitumen is a very viscous material and it has a very low chemical affinity with the surface of the aggregates. To resolve this problem, it is necessary to:
   
   - Reduce the bitumen viscosity by heating
   - Apply a big mechanical energy by an energetic mixing
   
   During this phase, humidity or dirt, present on the surface of the aggregates, could lead to an incomplete covering of the aggregate itself.

2. **Stripping Resistance**

   This represents the ability of bitumen to remain attached to the surface of the aggregates for the entire duration of the road service. The presence of water between bitumen and aggregates will lead to the phenomena called stripping, more precisely to the detachment of the bitumen film that covers the aggregates. The stripping can show itself by the loss of small chips from the asphalt surface, the tendency of the bitumen to detach from the surface, showing cracking and/or deformations.
The affinity between bitumen and aggregates can be improved by the addition of a small amount of additive ADHEBIT. These chemicals have the function of modifying the surface tension between the bitumen and the aggregates.

Contact angle is a measure of the (net) interaction of bitumen with aggregate. A large contact angle means that it is more difficult for the bitumen to spread and coat the aggregate. In particular, it becomes more difficult for the bitumen to penetrate into the small pores and crevasses on the aggregate surface necessary for so-called micro-mechanical adhesion, or for the bitumen to flow through dust particles on the aggregate surface.

ADHEBIT absorbs at the bitumen/aggregate interface and reduces the contact angle. The effect of ADHEBIT is to help coat the aggregate, wet out fine parts adhering to the aggregate surface and help the binder enter the microscopic crevasses on the aggregate surface. ADHEBIT also helps prevent the bitumen stripping from the mineral surface when the mechanical energy supplied by mixing is removed.
Thanks to its particular chemical structure, when added to the bitumen, the ADHEBIT molecules quickly migrate into the bitumen/aggregate interface. The hydrophilic head groups bind strongly to the site of the aggregate surface, the hydrophobic "tails" of the molecules anchor into the bitumen. In this way a chemical connection between bitumen and aggregates is created. ADHEBIT works as a bridge between the bitumen and the aggregates, guaranteeing an optimal and lasting adhesion.

ACTIVA offers two types of “adhesion promoter” additives characterized by high quality and high performance.

**ADHEBIT B-6040**

It is a cationic surface active molecule based on a mixture of amines, amides and imidazolines. It has a basic pH and it is the most commonly known and popular type of adhesion promoter. It is not expensive and easily available on the market, but has the disadvantage of being effective only with some kinds of aggregates depending on their mineralogical nature, normally with high percentage of silica content (acidic type); moreover, this type of adhesion promoter presents the problem of low thermal stability. ADHEBIT B-6040 has the hydrophilic head groups positive and binds strongly to the sites of the negative surface aggregate, the hydrophobic "tails" of the molecules anchor into the bitumen.

**ADHEBIT HA-573**

It is an anionic surface active molecules based on phosphate esters. This type of adhesion promoter is considered to be the best on the market. It has an acid pH and it is a very newgeneration of adhesion promoters. It is not expensive and has the advantage of effective with all kinds of aggregates independendly on their mineralogical nature (alkanine and/or acidic); moreover, this type of adhesion promoter presents very high thermal stability. ADHEBIT HA-573 has the hydrophilic head groups both positive and negative and bind strongly to the sites of the aggregate surface whether negative or positive, the hydrophobic "tails" of the molecules anchor into the bitumen.
Production and Quality Benefits

The use of ADHEBIT additives allows the coverage of the aggregates difficult to be coated and ensures a perfectly stable bond between bitumen and aggregates (acids and/or basics).

The use of ADHEBIT additives confers a greater flexibility of use to the asphalt mixes, in particular: at low temperatures, in the presence of moisture and at a great distance from the production site.

The use of ADHEBIT additives ensures a higher resistance to aging processes by slowing down the oxidation phenomena.

The dosage rates depend on the nature of the aggregates and the bitumen type used. Usually they vary from 0,1% to 0,3% of the bitumen weight; this means that for 1,000 kg of bitumen there are required between 1 and 3 kg of ADHEBIT.

ADHEBIT is added directly into the mixer during the production of an asphalt mix, using an automatic dosing system. Alternatively, it can be added directly in the storage tank of the bitumen while it is being loaded; this operation must be conducted so that the additive is added at the same time as the bitumen, making sure that at the end of the transfer of bitumen, the right quantity of additive has been added to the storage tank. The first solution is much more advantageous, since it avoids the modification of the whole bitumen stored in the tank, and gives higher flexibility as it allows to vary the dosage depending on the working conditions.
The adhesion between bitumen and aggregate can be predicted by laboratory testing methods. The procedures can be used to evaluate the effect of moisture on a given bitumen/aggregates combination with or without adhesion promoters. The European and International Standards are based on the analysis of the compatibility bitumen/aggregates in dynamic or static analysis and on the indirect loss of tensile strength of the asphalt after immersion in water.

In the laboratory test EN 12697-11 Part A, known as "Rolling Bottle Test", the aggregates are first coated with hot bitumen and then positioned in glass bottles filled with water at room temperature. The bottles spin for 24 hours and the samples are analyzed every six hours, via a visual assessment expressed as a percentage of aggregate stones covering. After the 24 hours test, the surface of the aggregates should be covered with bitumen for more than 60-70% of the surface in order to obtain a pavement having a good resistance to water exposure.
In the laboratory test ASTM D3625 and EN 12697-11 Part C, known as "Boiling Test", the aggregates are first coated with hot bitumen and then immersed in boiling water for ten minutes. Later on, the aggregates are evaluated, and the result of the test is expressed as a percentage of inert covered by bitumen. The coated surface, after the 10 minutes test, should be typically higher than 60-70% in order to achieve a good result and therefore good performance of the asphalt mixes.
Benefits at a glance

- Promotes bitumen/aggregates adhesion
- Ensures a perfectly stable bond between bitumen and aggregates
- Extremely Small Dose (0.1% - 0.3% of binder weight)
- Improves asphalt water resistance
- Improves the asphalt workability during paving and compaction phases.
- Improves the asphalt workability in extreme weather conditions.
- Reduces the production costs, allowing a reduction of the content of bitumen in the asphalt mix.
- Long Shelf Life (36 Months)
- Excellent coating (wetting): bitumen, during the mixing phase and manufacture, perfectly covers the aggregates. This action is called "Active adhesion". The bitumen, even in the presence of water and moisture, smoothly covers the aggregates.
- High stripping resistance: the bitumen film that covers the inert is perfectly fixed and enduring in time. This action defined as "passive adherence", represents the ability of the bitumen to remain attached to the surface of the aggregates for the entire useful life of the pavement.
- Antioxidant: the presence of special chemical compounds, slows down the natural process of oxidation of the bitumen. The antioxidant action decreases phenomena related to fragility and rapid aging pavement resulting in a longer conglomerates life.
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