RAW MATERIALS

Control of bitumen Emulsion Cold-Mixes behavior under real conditions

Introduction

Bitumen Emulsion Cold-Mixes (BEMIX), or Cold Mixes, are the future of bituminous pavement. Cold-Mixes offers advantages, compared to traditional Hot Mix Asphalt, in terms of reduction of environmental pollution, of energy and costs. In addition, the application is simplified and workmen are better protected against noxious fumes.

Selection of emulsion depends on weather conditions, aggregate type and ability of emulsion to coat the aggregate. Thus, it is primordial to optimize emulsion formulation, according to the conditions of use to ensure the quality of the bituminous pavement. In this note, we will follow up the impact of different application conditions, such as temperature and humidity of aggregate, on the behaviors of a bitumen emulsion under real conditions.

KEY BENEFITS

VERSATILE

ACCURATE

EASY

Bitumen Emulsion Cold-Mixes (BEMIX)

BEMIX are oil (bitumen) in water emulsions stabilized by additives (cationic surfactant). The emulsions are formulated to break chemically (mainly because of a switch of pH) upon contact with a mineral surface.

The **breaking** leads to a distribution of the bitumen around granulates. Depending on use a rapid, medium or slow breaking emulsion may be used.

This step is followed by the **curing**, resulting in the development of the cohesion. The water is removed by evaporation, by pressure (rolling) and by adsorption onto the aggregate surface. The result is a continuous film which maintains aggregates in place with strong adhesive bonds.

These two parts may be affected by aggregate moisture, temperature, mineral composition and aggregate size, etc. Thus, it is important to study the behavior of the formulation under real conditions of use.

The Crystal can discern the important steps of the creation of bituminous pavement:

- **Breaking**
- **Curing**

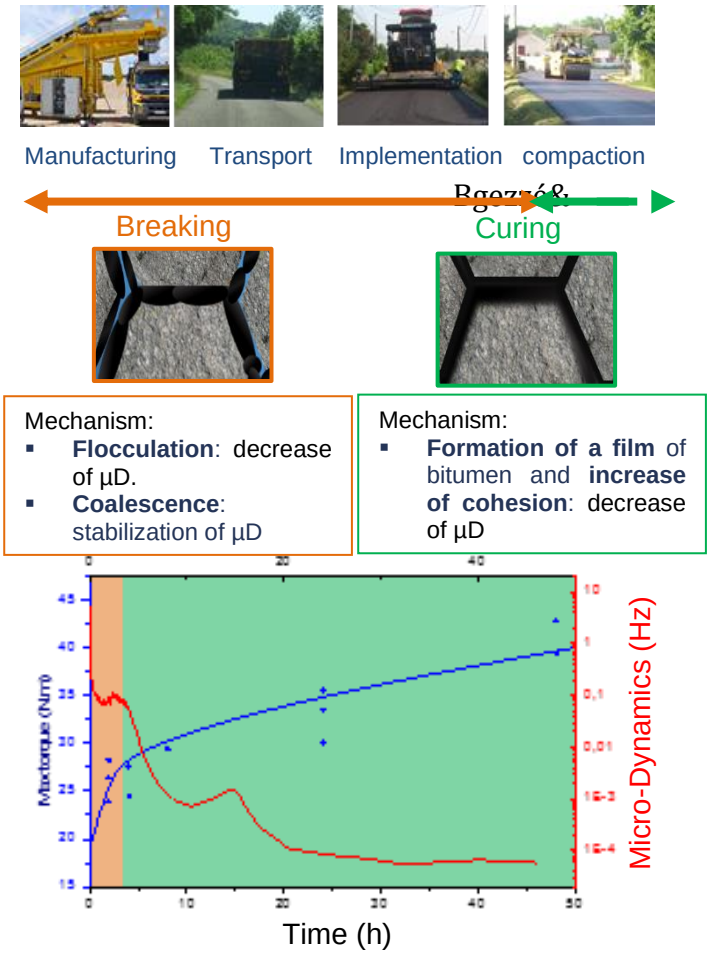

Figure 1: Maximum torque (blue) and Micro-Dynamics (red) in function of time and forr bitumen emulsion mixture.

Method

Samples were composed of granulate with a fine-grained (0/2 millimeters) and 8.3% of emulsion. Emulsions are composed of 65% of bitumen, water and 1% of additives (slow setting emulsion).

The humidity of granulates was controlled by adding water in dried sand. To simulate “real” conditions, emulsion and granulate were mixed during 30 seconds and 11 grams of mix was compacted in a sample cup. Analyses were performed at constant temperature.

Experimental results

➢ Impact of aggregate moisture

Figure 2 shows the Micro-Dynamics as a function of time for three different level of moisture in the aggregates at 35°C. It can be observed that the flocculation step as well as the film formation step is delayed with increasing water content. Indeed, if the pores are saturated with water, the adsorption of the emulsion onto the aggregates is slowed down, which delays flocculation and coalescence of the emulsion. Hence, the application need more time.

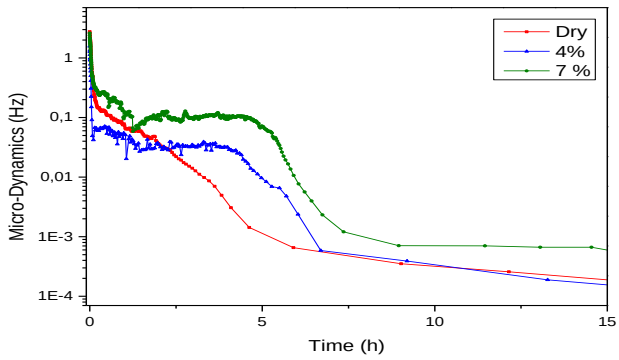

Figure 2 Micro-Dynamics in function of time for three samples with different humidity at 35°C.

➢ Impact of the temperature

Figure 3 shows the application at three different temperatures, which can occur during pavement work on a street. The behavior of the sample at 18°C is very different from 35°C and 50°C. After 20 hours, the breaking step is not over, the sample does not show the curing step. A penetration test confirms the low cohesion of the sample. At 35°C and 50°C, the samples showed complete breaking after 3 hours and 1 hour, respectively, and a maximum cohesion is observed after 20 hours and 10 hours respectively. A higher temperature limits the stability of an emulsion but tends to decrease the curing step because of a higher evaporation of water.

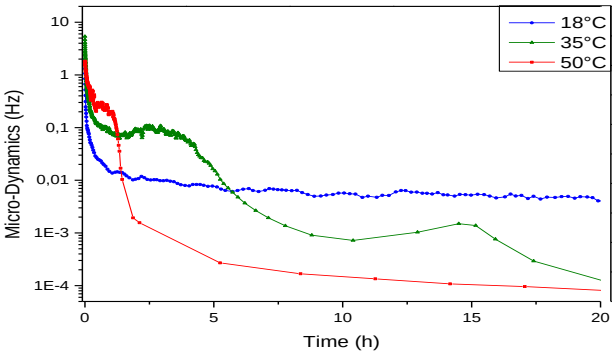

Figure 3 Micro-Dyanmics in function of time for three samples at different temperature.

All results were in accord with the observation on site. The use of this bitumen emulsion is very difficult or impossible at 18°C.

CONCLUSION

The RHEOLASER Crystal can follow the breaking of a bitumen emulsion but also the increase of cohesion during curing step.

In this note, RHEOLASER Crystal follow the impact of aggregate moisture and temperature on the behavior of BEMIX in real condition of use (mix and compaction of the sample).

RHEOLASER Crystal allowed to anticipate the impact of weather condition on the creation of bituminous pavement and so to optimize BEMIX formulation.