Bitumen recovery from bituminous mixtures using the rotary evaporator

R-215, V-855, V-700

In this Short Note we present the method for the recovery of soluble bitumen from bituminous mixtures. Bitumen is recovered from a toluenic solution according to the Swiss Standard SN 607 403a-NA [1] by vacuum evaporation using a rotary evaporator after separation of the insoluble matter from recoverable binder. The two evaporation steps are performed in one hour only.

1. Introduction

Grip, stability and longevity are only a few key words that apply to high quality streets. The top layer of an asphalted street is made of a defined mixture containing bitumen and aggregate particles. Depending if the street is a mountain pass or an ocean drive, the mixture is different, the proportion of its components is essential for the quality. In Switzerland, for example, harsh winter conditions demand for special asphalt composition.

For quality testing of asphalted streets, bitumen has to be separated from the aggregate particles for further testing. The separation process is split into sample preparation, and bitumen recovery. Here we highlight the recovery of soluble bitumen from bituminous mixtures used in road, airfield or similar suitable for further testing [2]. We refer to the Swiss standard SN 670 403a-NA [1] which is based on the European standard EN 12697-3 [2]. The rotary evaporator is the central element in this process.

2. Experimental

The process refers to either loose or compact asphalt material.

A typical sample is shown in Figure 2. It is taken from the top layer of an asphalted street. Before starting the bitumen recovery process the sample has to be dried from water in a drying cabinet. In order to yield between 120 g and 150 g recoverable binder, a representative sample of about 2.5 kg is dissolved in 1.5 L toluene. The mixture is agitated until all of the soluble bitumen has been dissolved. Then the bitumen solution is separated from the insoluble gravel material by centrifuging.

The bitumen itself is recovered by vacuum distillation using a Rotavapor® R-215. To separate solvent from bitumen the heating bath has to be preheated to 145 ± 1 °C and a vacuum is applied to feed the solution to the evaporating flask. Subsequently, the vacuum is stepwise lowered to 400 - 500 mbar in order to evaporate toluene at a rate of 40 - 50 mL/min. For the detailed procedure see [1].

When less than one drop per 30 seconds is distilled, the collection vessel is removed, emptied, and re-attached. In order to remove residual solvents from the bitumen the vacuum is adjusted to 19 mbar within 2 minutes, for example by using a gradient and the Vacuum Controller V-855. The final vacuum of 19 ± 1 mbar is kept for 20 minutes.

Finally, the recovered bitumen is immediately collected in a preheated form and to be tested for its quality, e.g. the determination of needle penetration and softening point.

3. Result

The process according to SN 670 403a-NA or EN 12697-3 yields the recovered viscous bitumen for further analysis.

4. Conclusion

Bitumen recovery according to SN 670 403a-NA which is based on EN 12697-3 can be successfully performed using an R-215 rotary evaporator equipped with the Vacuum Controller V-855 and the Vacuum Pump V-700. With this system, both evaporation steps are precisely controlled and convenient to handle.

5. Acknowledgement

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6. Literature
