Summary

In connection with the launch of Superpave, a bitumen classification system, about 30 years ago in the USA, the instrument Dynamic Shear rheometer, DSR, which was central to this methodology, was used daily for measuring the viscoelastic properties of bitumen. At an early stage, DSR could not perform low temperature measurements that may occur on a road. The DSR measurements then had to be supplemented with the device Bending Beam Rheometer, BBR. During the last decade, the performance of the new DSR equipment has improved and today it is able to perform measurements at temperatures down to -40 °C, which is the lowest temperatures that a road can be exposed to.

Even though most studies show that it would be possible to replace BBR with DSR for low-temperature measurements, further comparative studies are required between the two devices before it can be secured and realized. The purpose of the study has therefore been to test a measurement procedure with DSR to investigate whether it is possible to replace BBR measurements with DSR measurements. In addition, an investigation with DSR on the impact of aging on the types of bitumen to be used is made, to study the sensitivity and precision of the DSR equipment after aging changes in bitumen.

The basis for comparisons between BBR and DSR measurements are two types of bitumen to be tested, namely bitumen 70/100 and polymer-modified (PMB) bitumen, Nypol 73. The DSR measurements are performed in LTH's rheology laboratory at the same time as the company Nynas AB performs the BBR measurements in parallel. In order to be able to compare the measurements between the two devices, parallel measurement series are made. The same samples that Nynas prepares and performs BBR measurements on, are then tested with the DSR machine at LTH. Measurements performed with the DSR machine have been performed with frequency sweep and supplemented with MSCR test (Multiple Stress Creep Recovery Test).

From the experiments performed, results were obtained on parameters used to evaluate the bitumen’s rutting, fatigue resistance and low temperature properties. To assess the low-temperature properties, two t-low parameters were calculated, the stress after 60 seconds load, S(60) and the gradient after 60 seconds, the m-value m (60). The results showed that the resistance to low temperature cracks decreases with aging of bitumen for the two bitumen types as t-low for S(60) and m(60) increases after aging treatment, which was performed in accordance with the Superpave standard. In addition, the results showed a clear statistically significant correlation between BBR S(60) and DSR S(60) for both bitumen types. Compared to m(60), the correlation between DSR and BBR is weaker for both bitumen types. This shows that there is no statistically significant agreement between DSR and BBR with regard to m(60).

The conclusions are that DSR can replace BBR in the assessment of low-temperature properties of bitumen, and this is particularly true for S(60). In addition, the aging of bitumen exhibited a stepwise logical change with DSR, both for S(60) and m(60), which proves the methods sensitivity to change and repeatability.