Studies of the Pumpability of Sooted Oils

Using the Extended Range Scanning Brookfield Technique

- Highly sooted diesel engine oils (>5% soot) have been identified as a source of pumpability problems at moderately low temperatures.
- As a consequence, the HDEOCP requested ASTM Subcommittee 7 to establish a task force (LOTRUO) to investigate methods of determining the low-temperature pumpability of sooted oils.
- The primary concern is that soot may not only contribute viscosity to the oil but may also develop structures that alone, or in concert with oil gelation, curtail engine oil circulation under starting conditions.
- Recent reports to the HDEOCP have primarily covered activities using the MRV-TP1.
- Commensurate work using the Extended Range Scanning Brookfield Technique was also thought to be of interest to the HDEOCP since it has provided considerable amount of information on sooted oils

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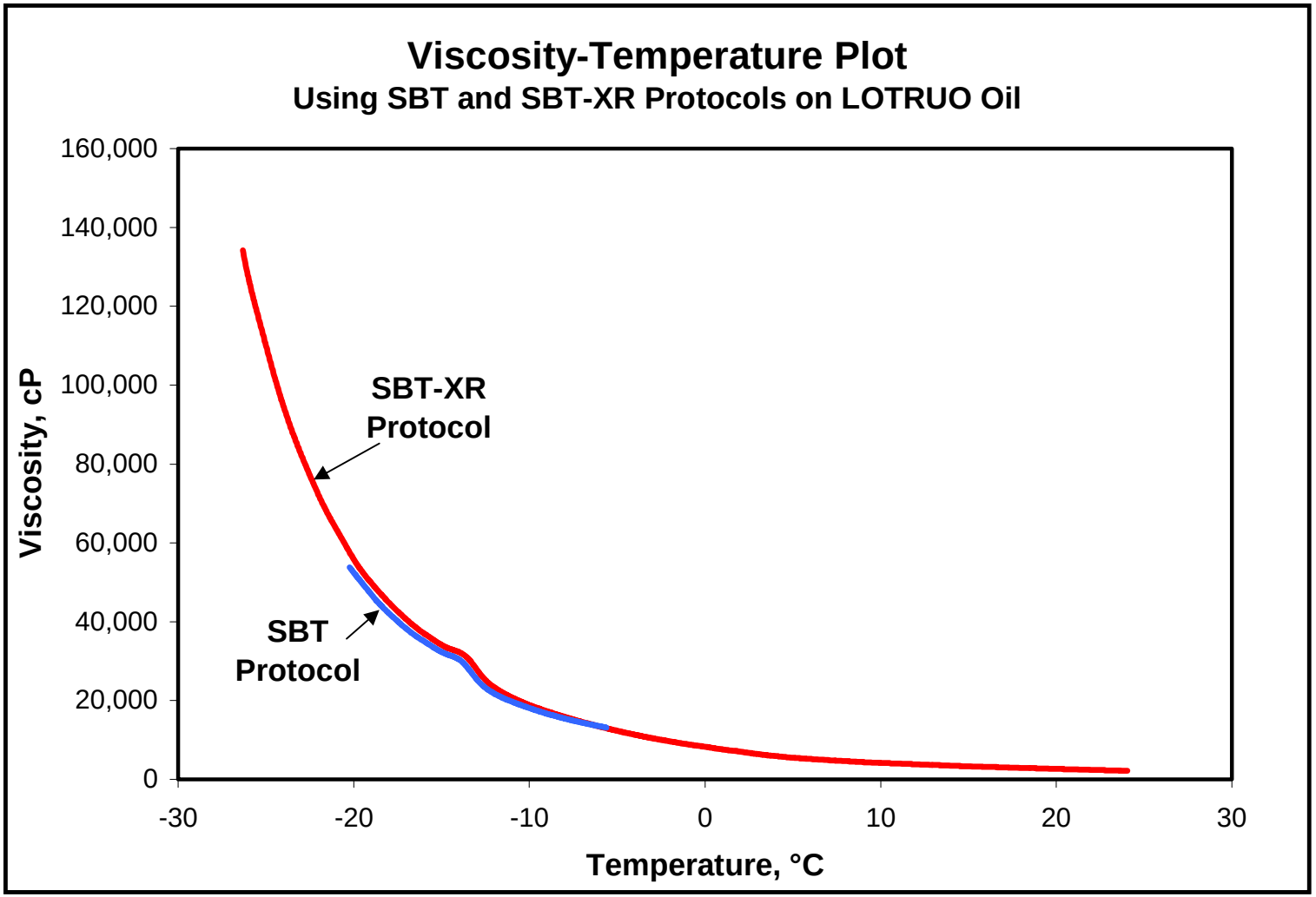
The Extended Range Scanning Brookfield Technique (SBT-XR)

- The SBT-XR generates the entire viscosity-temperature curve of a sooted oil over a wide temperature and viscosity range. From this information viscosities at desired temperatures can be obtained.
- Although the SBT-XR analysis is more rapid than the single-value approach of the MRV-TP1, results using well-behaved oils (normal exponential viscosity-temperature relationship) agree.
- The technique is sensitive and repeatable with both gelation and soot structures.
- The SBT-XR technique can cover a viscosity range of 300 to approximately one million centiPoise from 25°C down to -60°C.

- Results using the SBT-XR agree closely with shorter viscosity range Scanning Brookfield data.



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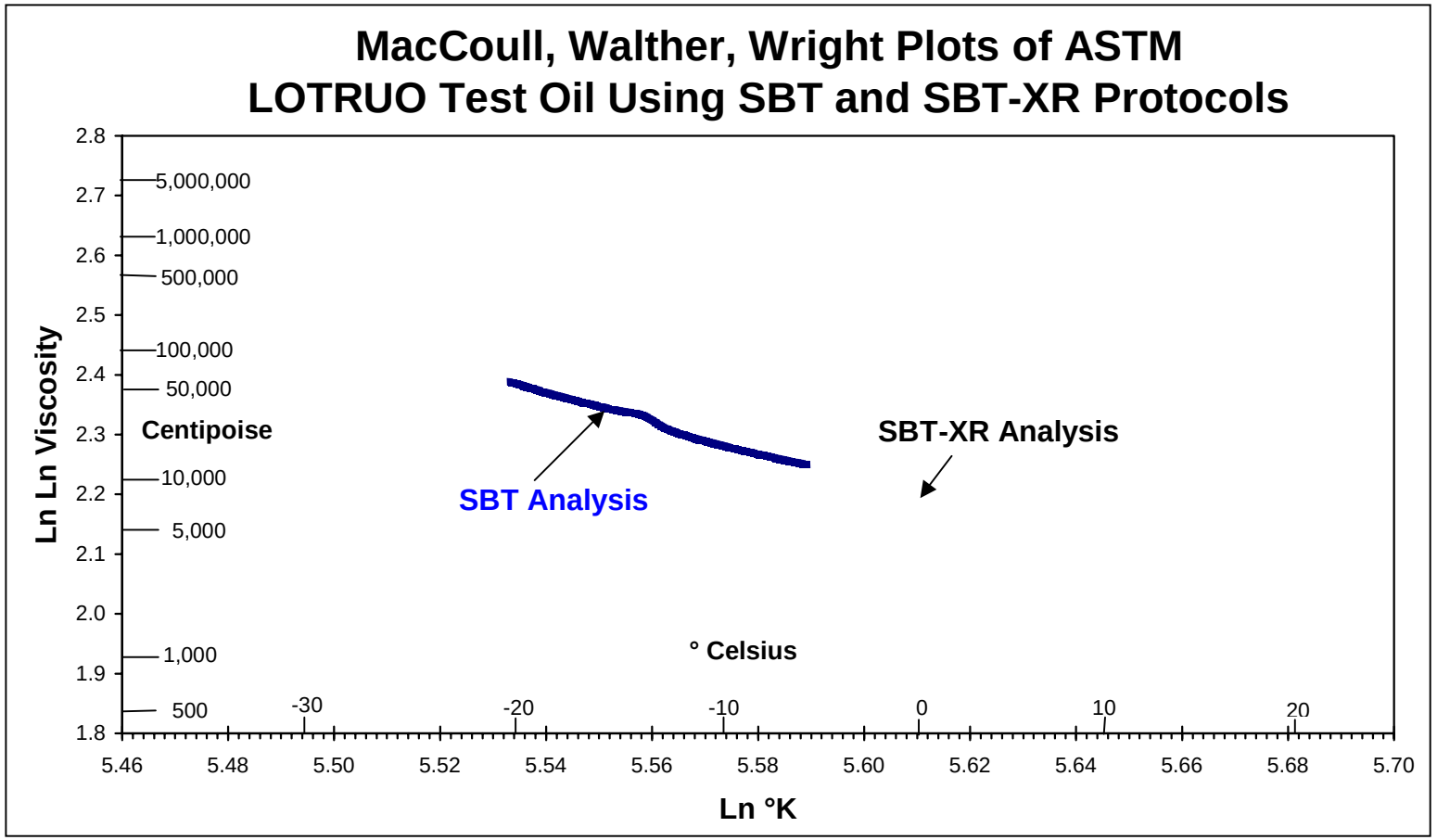
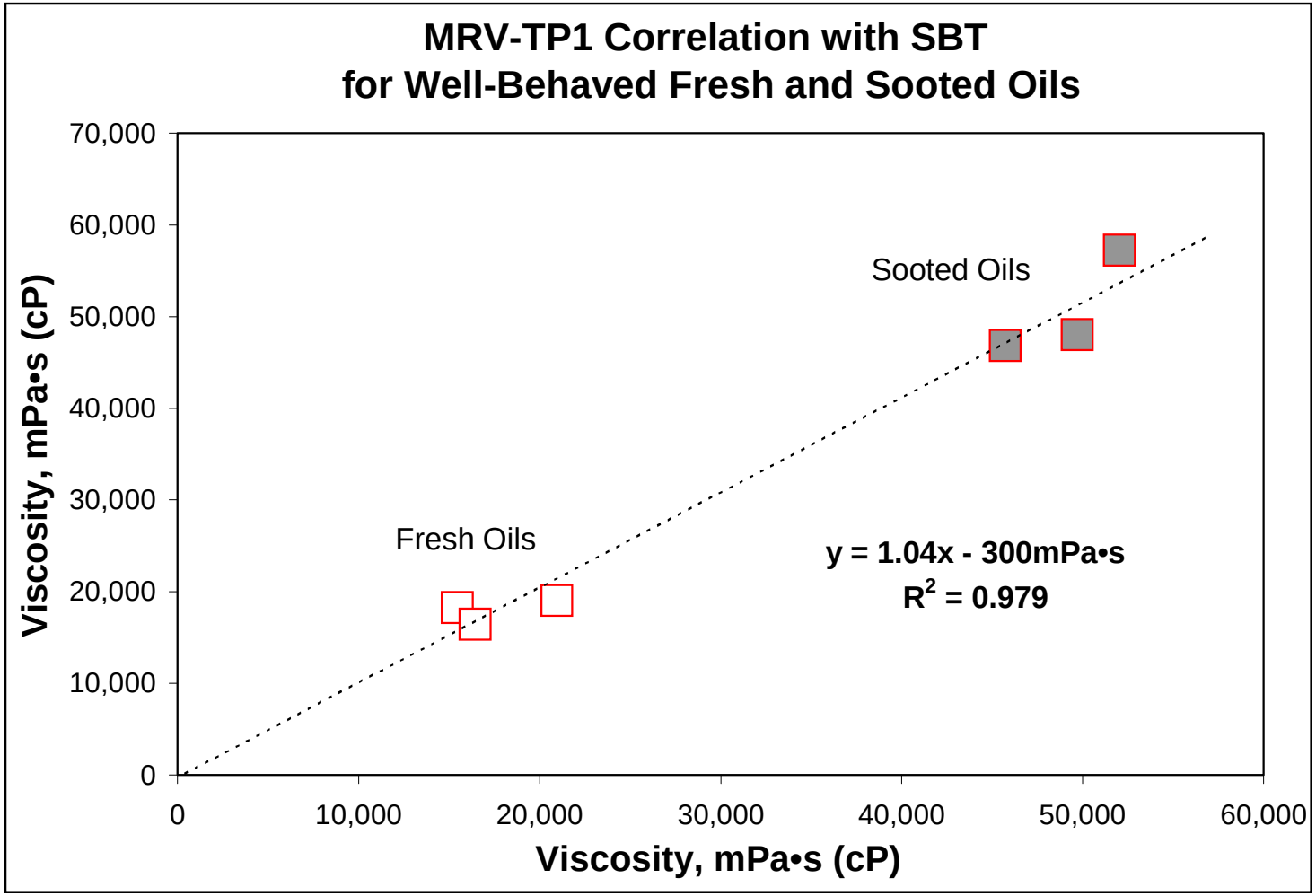
- MacCoull, Walther, Wright plot of both the SBT and SBT-XR shows the close agreement



- The MRV-TP1 and SBT-XR correlate closely with well-behaved oils



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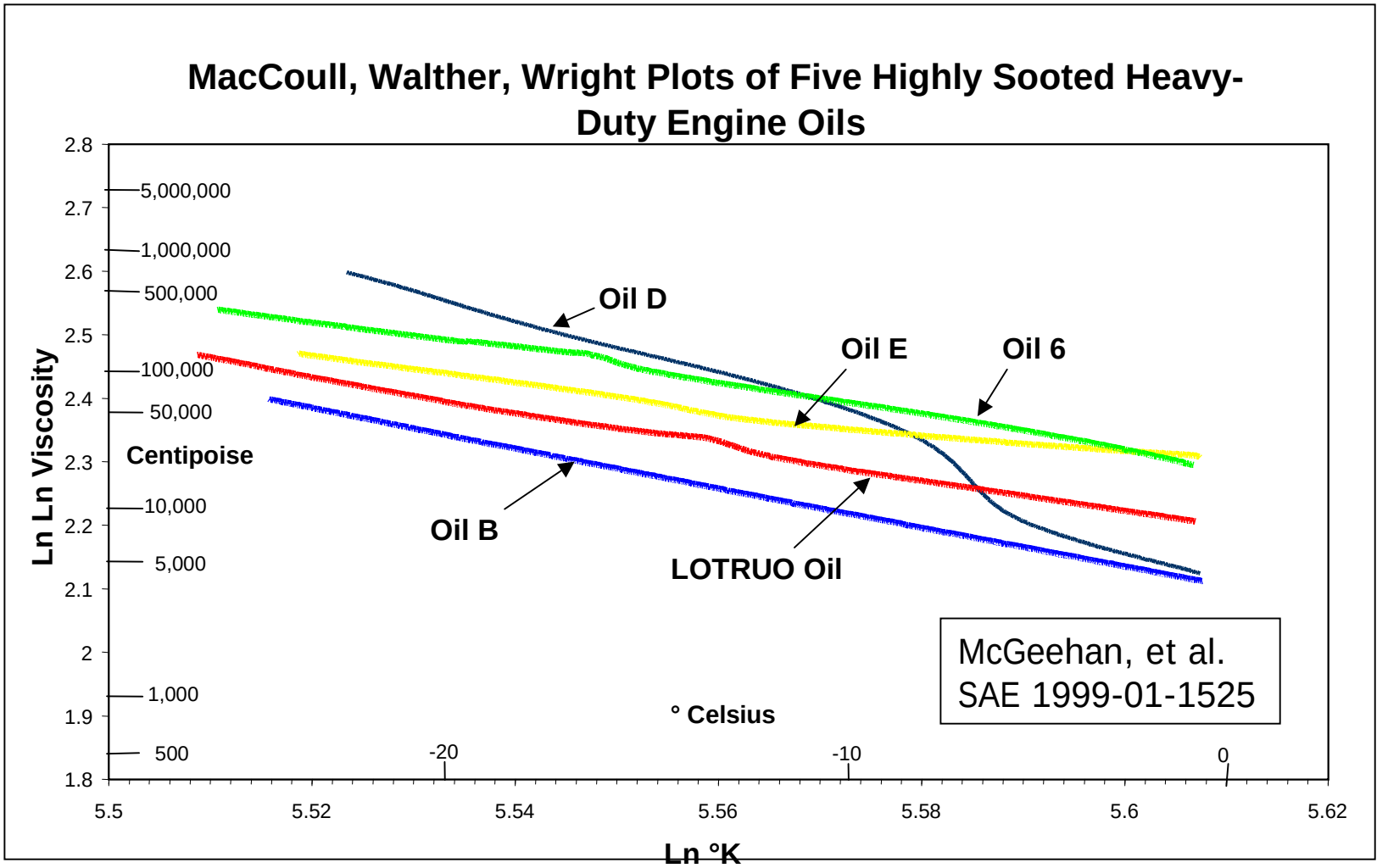
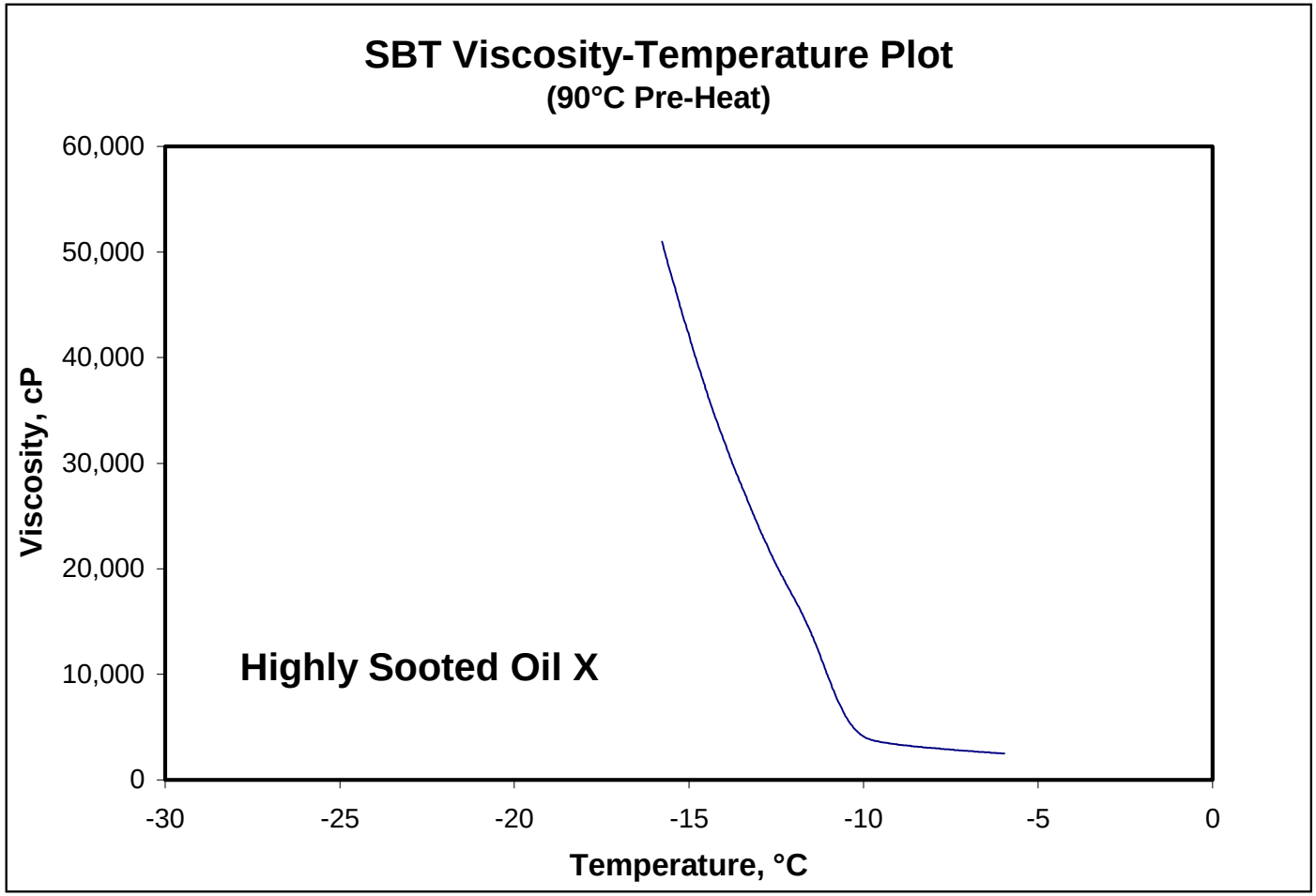
- Sooted oils show a wide range of viscosity-temperature response not evident from single point measurements



- Some sooted oils also show significant gelation



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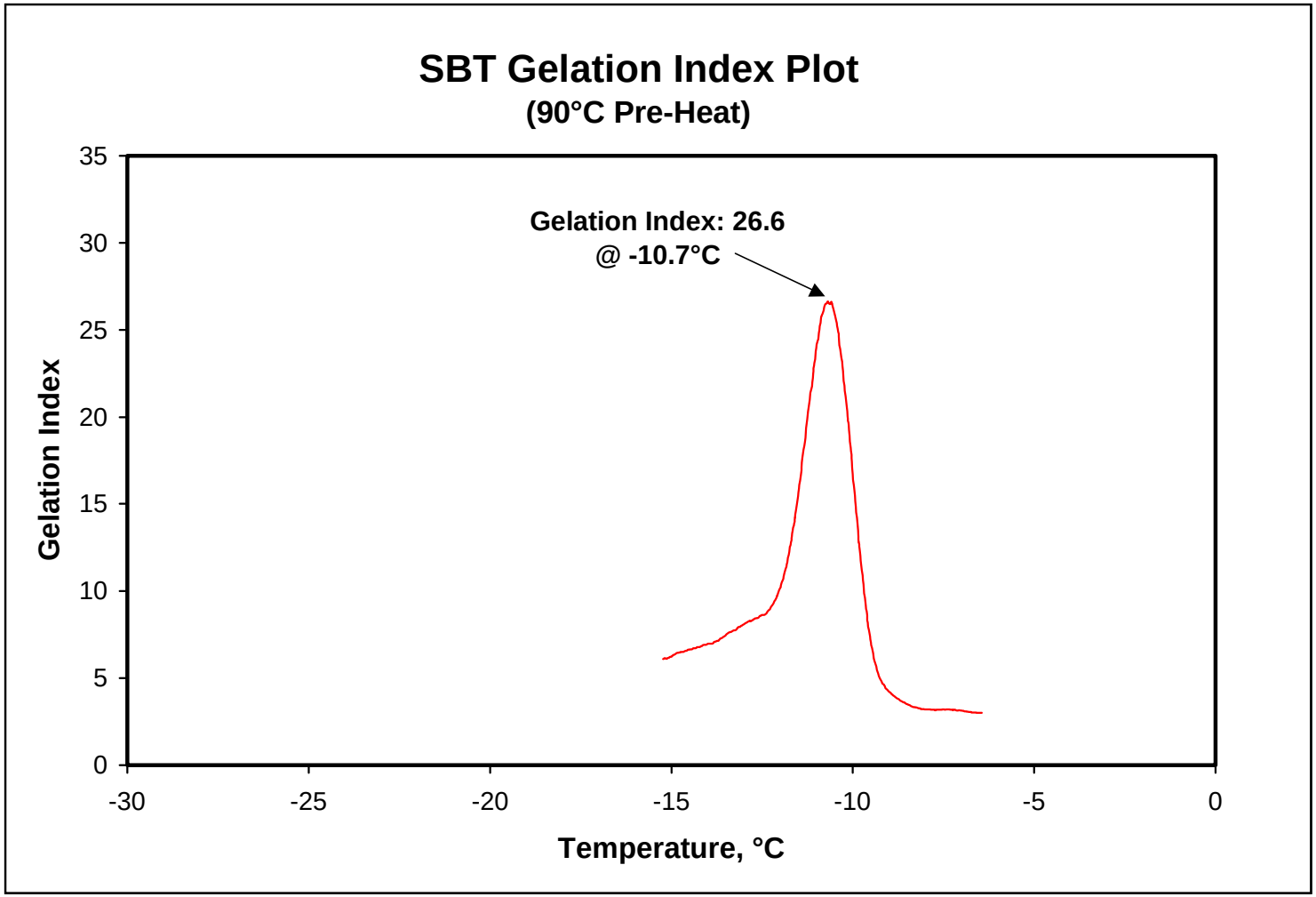
- The Gelation Index of sooted oils may result in air-binding pumpability problems



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Summary

- The extended range Scanning Brookfield protocol (SBT-XR) can provides the complete viscosity-temperature regime of sooted oils in one test.
- The procedure is repeatable and reproducible.
- The SBT-XR and MRV-TP1 agree closely with well-behaved oils (oils showing the exponential viscosity-temperature relationship of non-structure-forming engine oils.
- Gelation and soot structures are both evident in the SBT-XR data thus far generated.
- Results using the SBT-XR agree closely with shorter viscosity range Scanning Brookfield data.
- A round-robin on sooted oils using the SBT-XR protocol is being considered. Viscosity values will be taken at desired low temperatures as well as indicate Gelation Index or presence of soot structures.