

EFFECT OF CRUMB RUBBER ON THE RHEOLOGICAL PROPERTIES OF ASPHALTS AFTER LONG-TERM OXIDATIVE AGING

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LITERATURE

- Arizona – Chip seal (SAM, SAMI) (TRB 1307)
 - Retarded reflective crack propagation in overlays
 - Reduced spalling of AC around potholes and larger cracks.
- Arkansas – Plusride (TRB 1639, 1998)
 - Improved fatigue resistance
 - Minimized bleeding because the rubber and asphalt combine to form a more elastic binder.

LITERATURE

- California – Plusride and SAM (1988)
 - Reduced reflective cracking
 - Thinner sections of rubberized asphalt concrete have outperformed thicker sections of dense-graded asphalt concrete hot mixes.
 - Cost effective (1997)
- Florida – Open-graded surface mixes
 - Improved durability and pavement life.

LITERATURE

- Texas – Wet process (SAM, SAMI) (1996)
 - Reduced fatigue and thermal cracking of AC pavements.
- Minnesota – Plusride Overlays (1988)
 - Moisture sensitivity of CRM mixtures was similar to the unmodified mixtures.
 - CRM mixtures showed greater ability to dissipate stress through strain.
 - Problems with raveling.

LITERATURE

- United Kingdom – Dry Process (3rd E&E Congress)
 - Better fatigue resistance.
 - **Worse permanent deformation.**
 - **Large reduction in asphalt mixture stiffness.**
- Italy – Dry process (3rd E&E Congress)
 - Reduction of phase angle.
 - Enhanced the fatigue resistance.
 - Increased the elasticity.
 - Enhanced the rutting resistance.

LITERATURE--SUMMARY

- Asphalt-rubber pavements, in general, will perform better than conventional asphalt pavements.
 - Reduce traffic noise.
 - Reduce reflective cracking
 - Reduce fatigue cracking.
 - Reduce thermal cracking.
 - Reduce rutting potential.
- Moisture sensitivity is the same as regular mixes.

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 - Reduce rutting potential.
- Moisture sensitivity is the same as regular mixes.
- **Cost effective ???**
- **Long-term aging???**

OBJECTIVE

- **To determine how the rheological properties of rubber-treated asphalts varied with aging time when compared with untreated asphalts aged at temperatures in the pavement temperature range.**

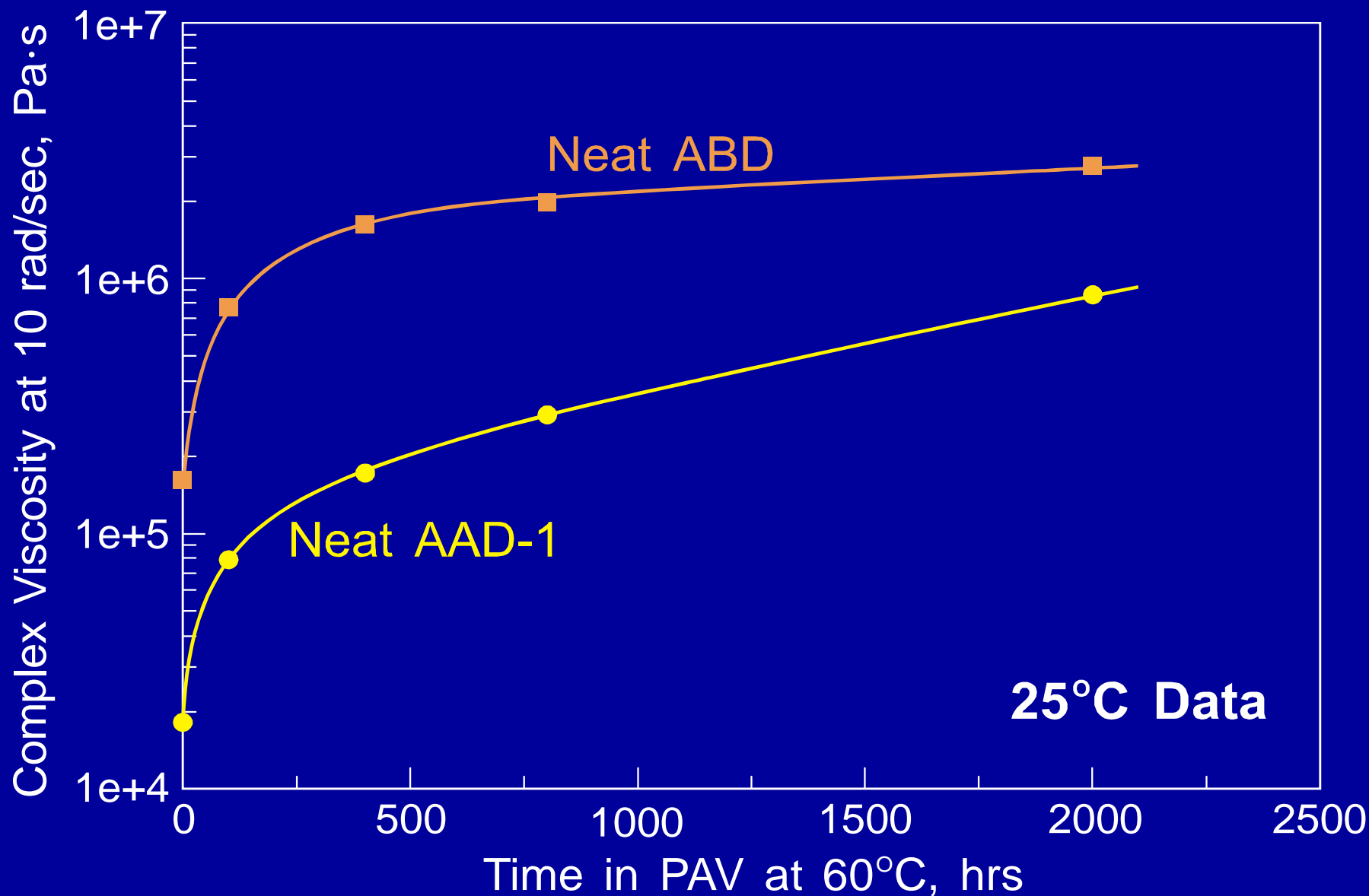
EXPERIMENTAL DESIGN

- **Materials**
 - **Asphalts AAD-1 and ABD**
 - **GF40**
- **PAV**
 - **Asphalts mixed with 13.3 mass % rubber**
 - **PAV at 60°C at 2.1 MPa for 100, 400, 800, and 2000 hrs.**

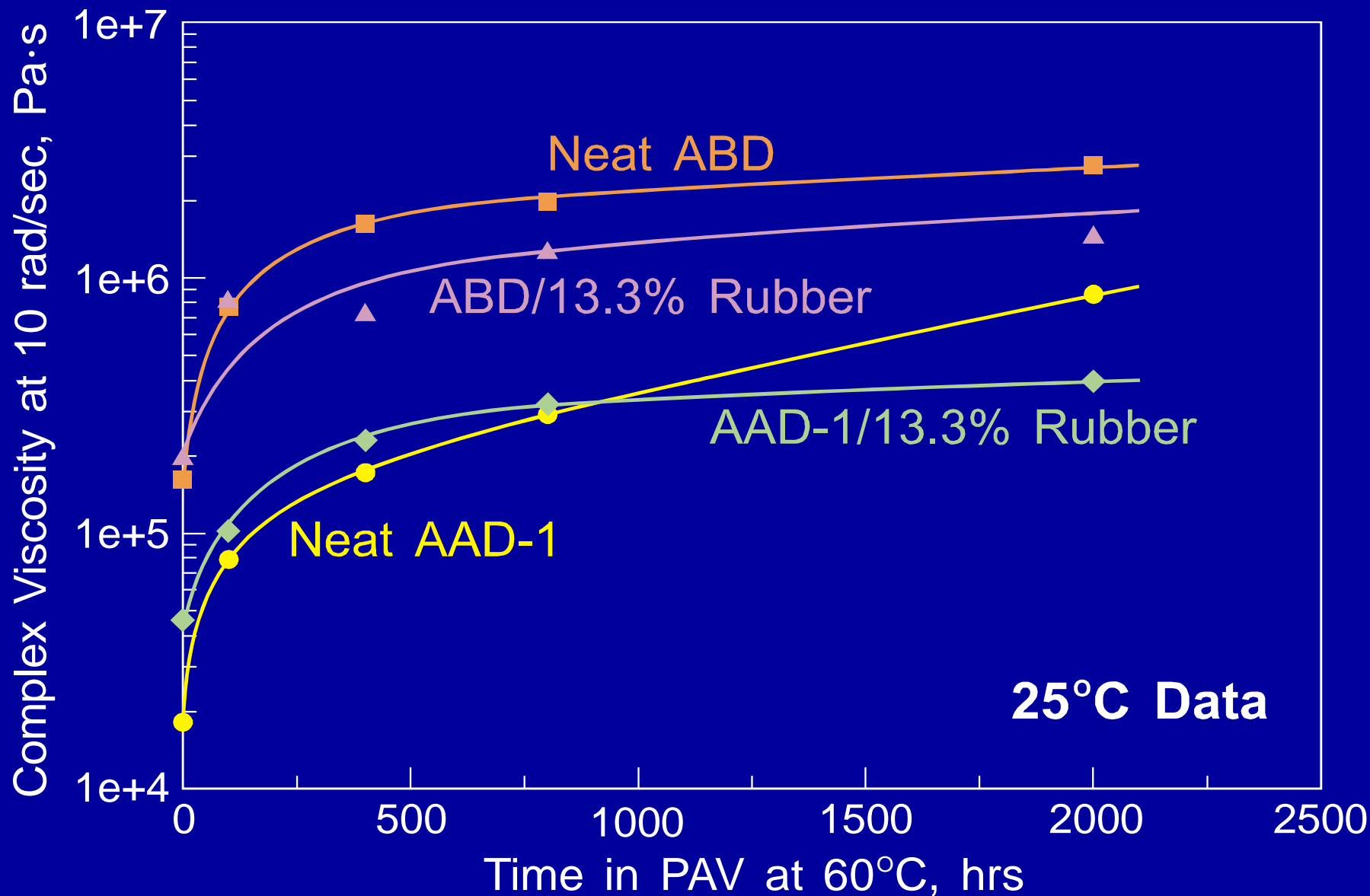
ASPHALT PROPERTIES (MRL Library)

	<u>AAD-1</u>	<u>ABD</u>
• SHRP PG Grade	PG58-28	PG58-10
• Vis @ 60°C (poise)	1055	2112
• Asphaltene (n-heptane)	20.5	7.0
• Polar aromatic	41.3	52.7
• Napthene aromatic	25.1	28.4
• Saturate	8.6	10.4
• Element		
– Sulfur (mass, %)	6.90	1.60
– Vanadium, ppm	310	62
– Nitrogen, %	0.77	1.2
– Oxygen, %	0.9	1.2
• Functional Group		
– Carboxylic acids	0.015	0.025
– Sulfoxides	0.036	0.024

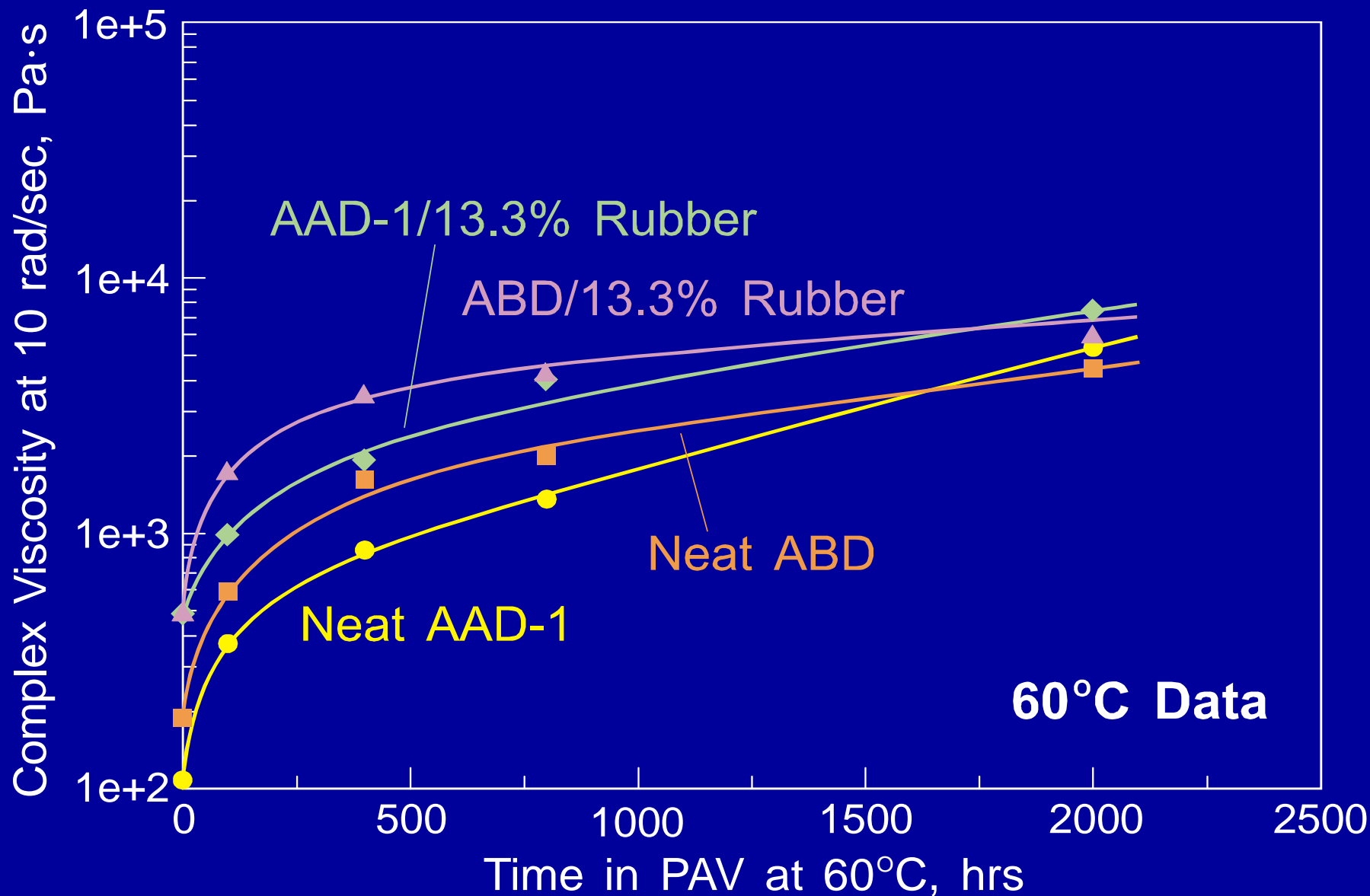
EFFECT OF ASPHALT ON AGING KINETIC



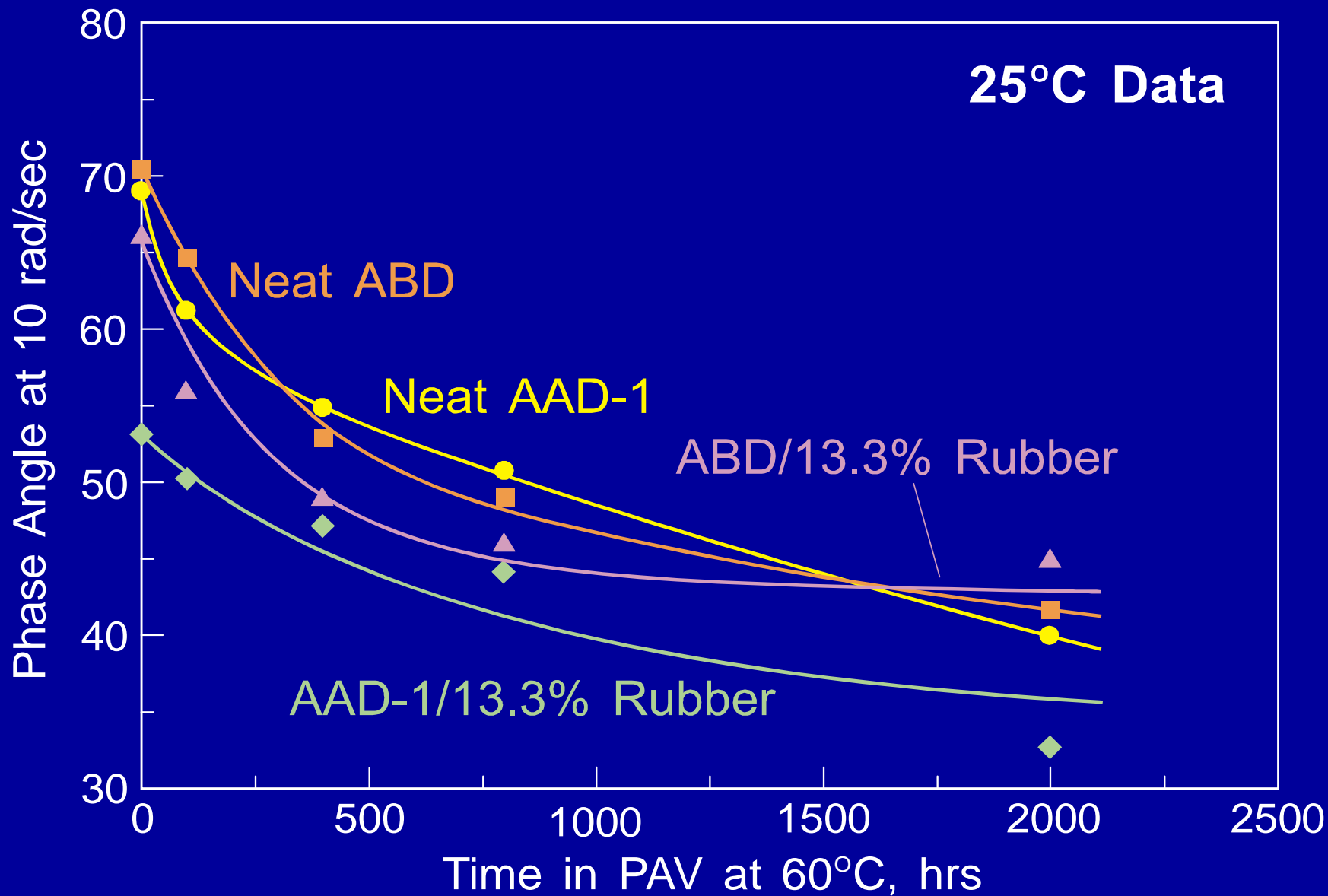
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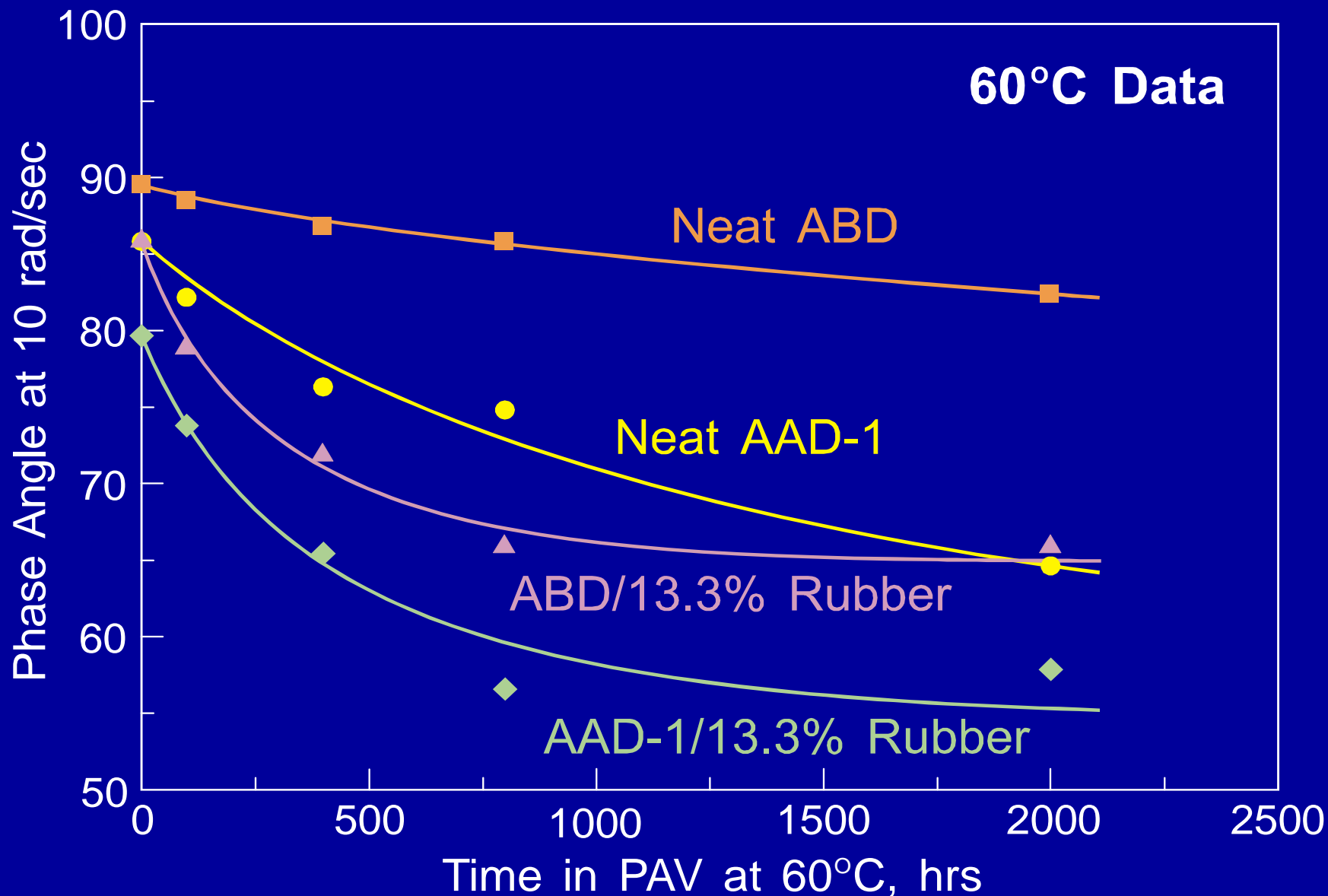
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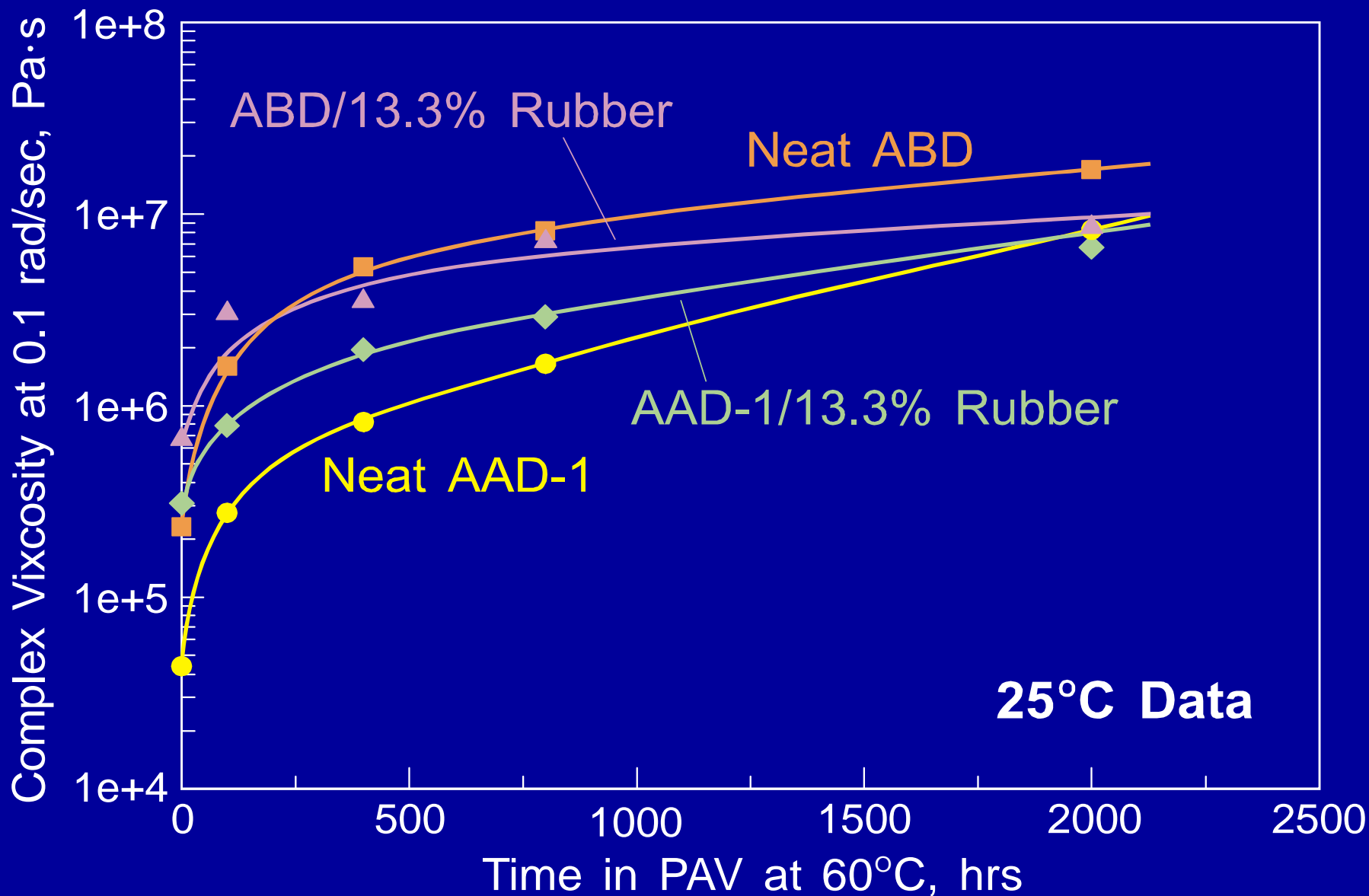
EFFECT OF RUBBER ON CHANGE IN PHASE ANGLE



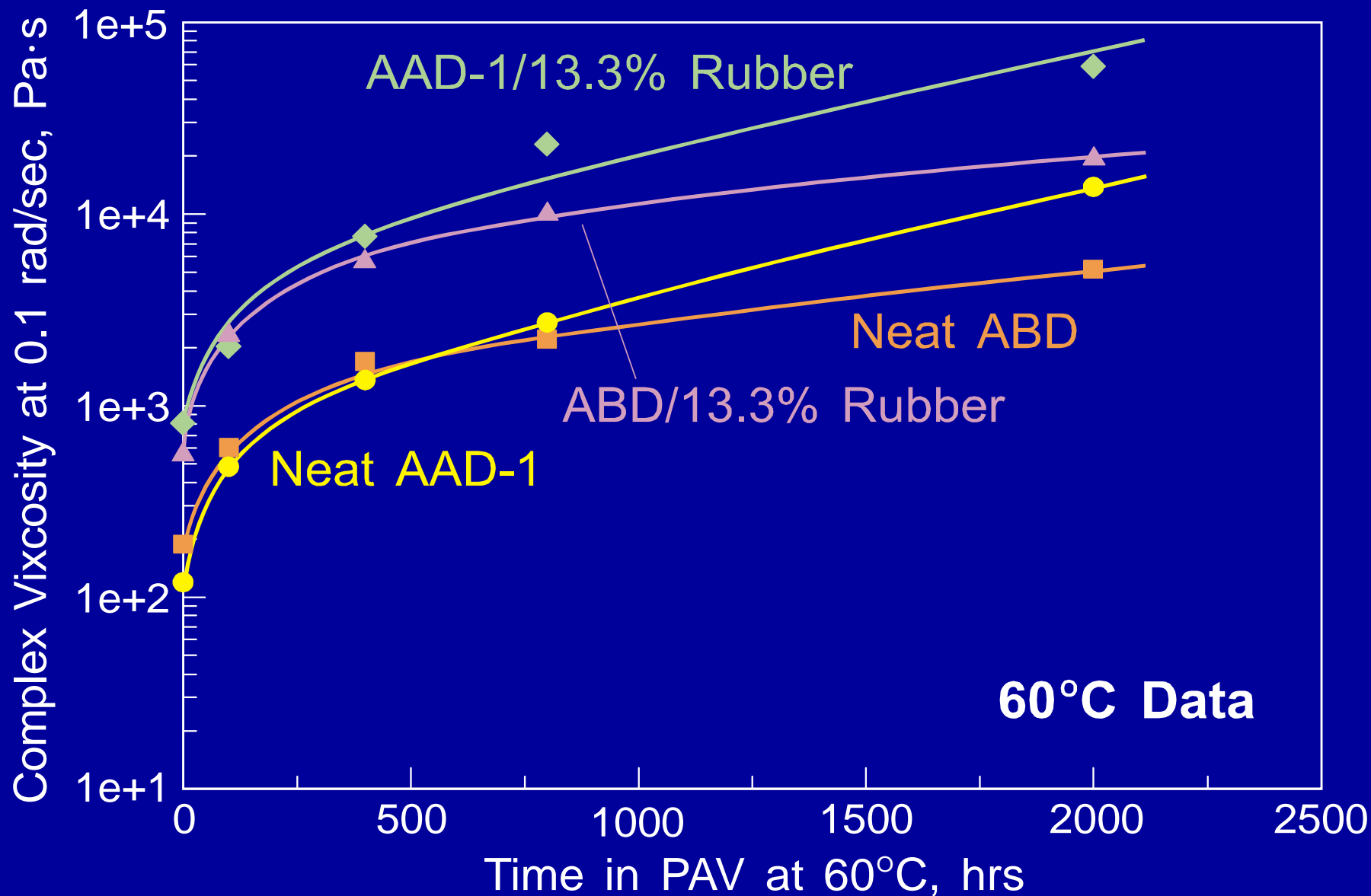
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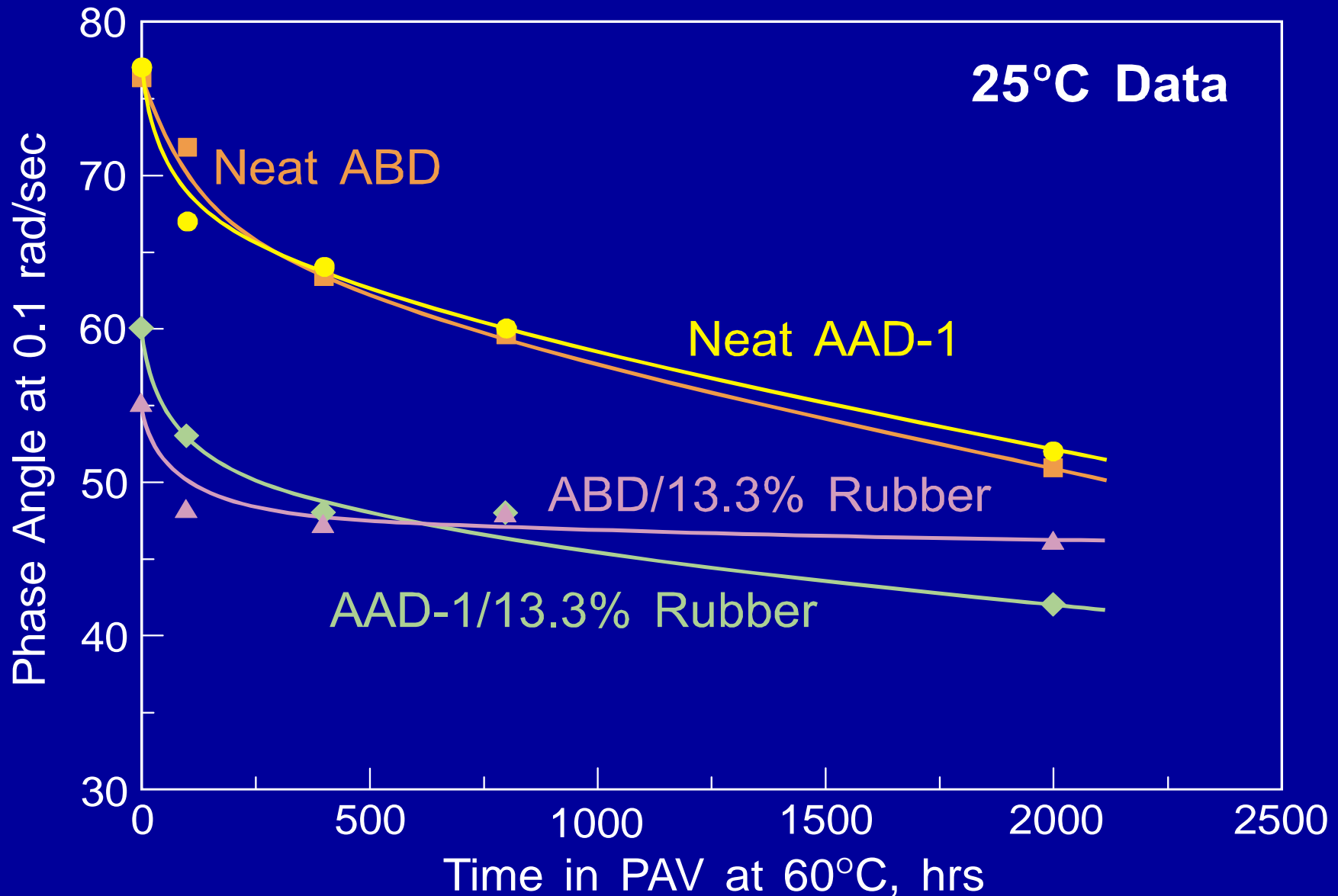
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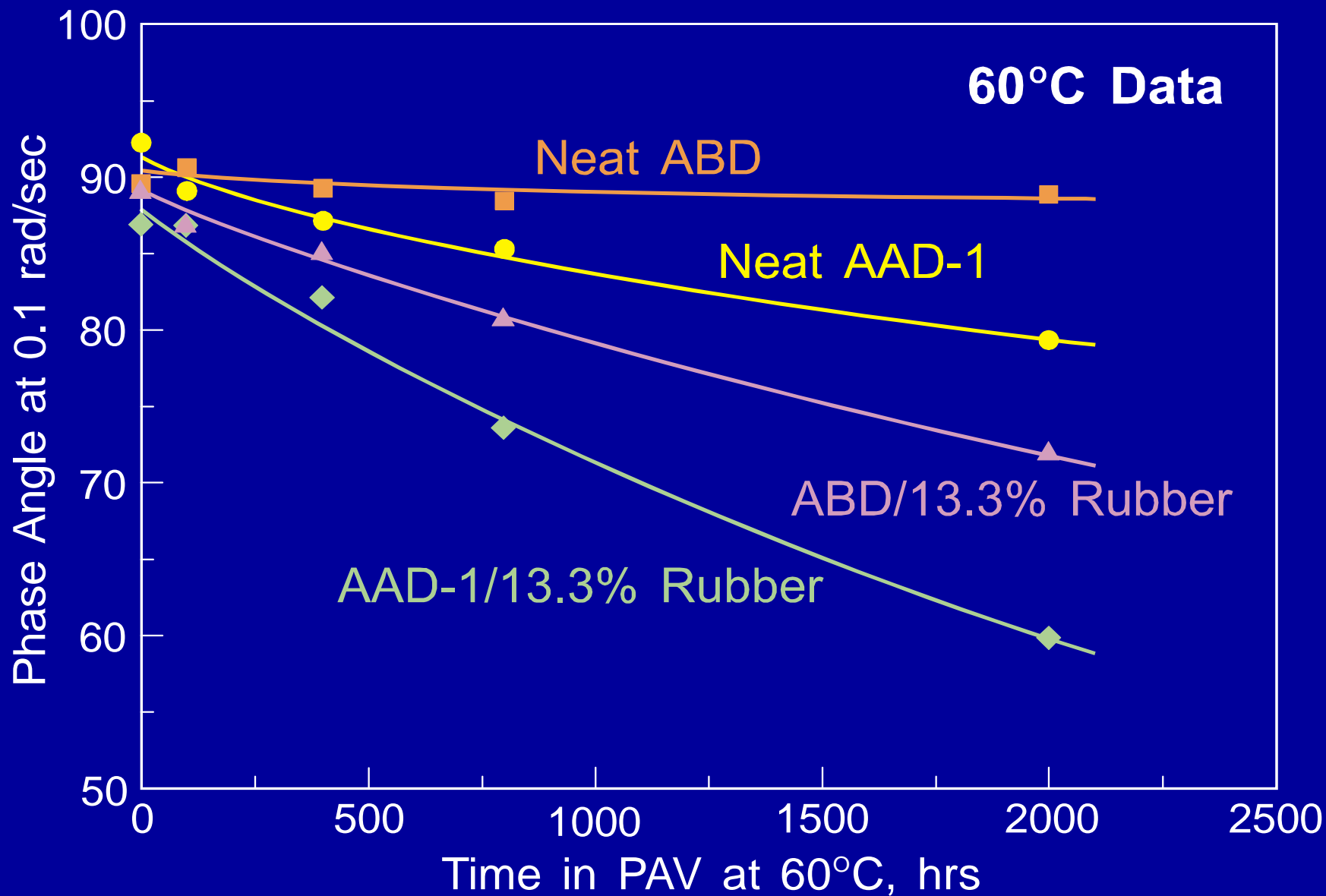
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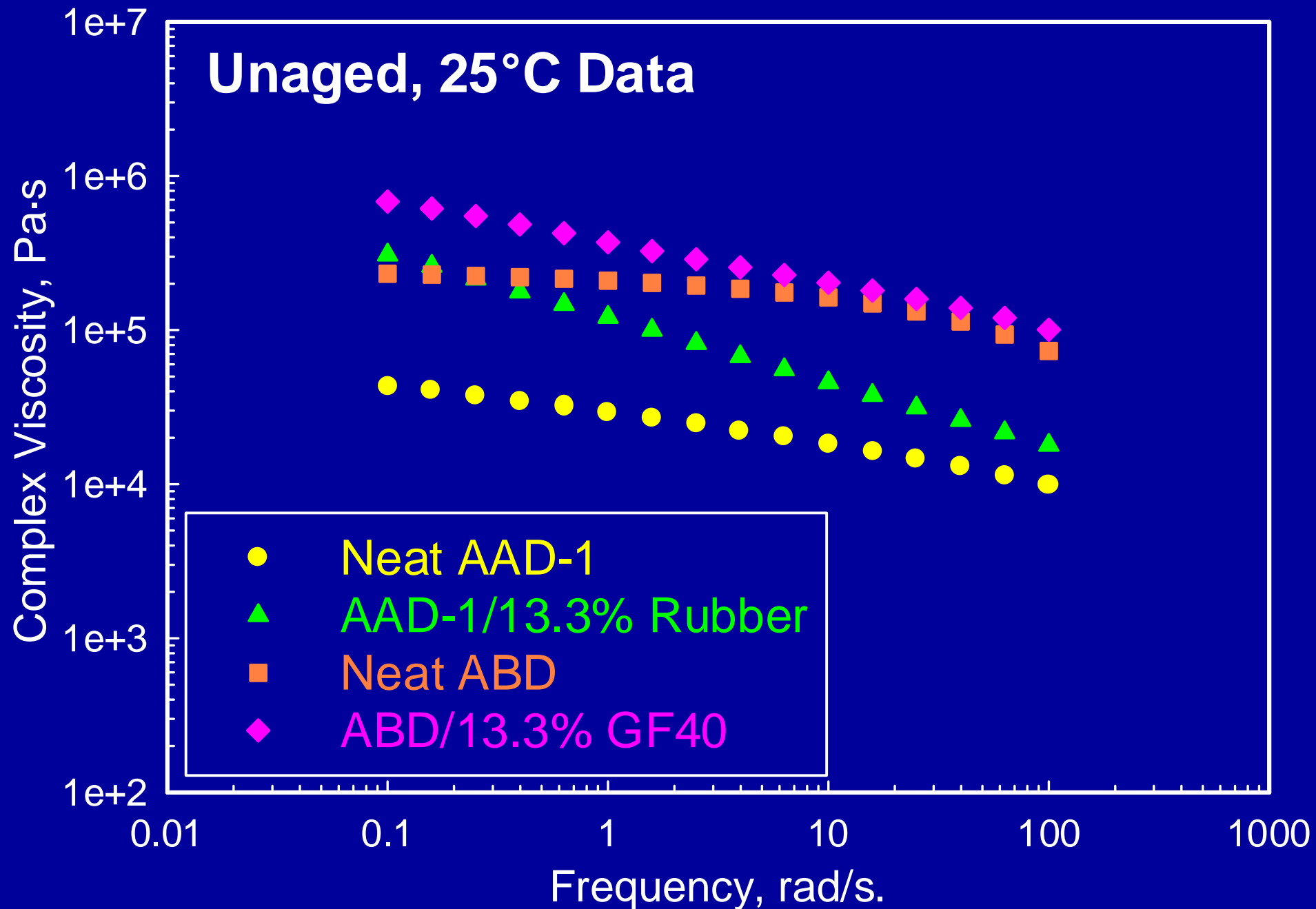
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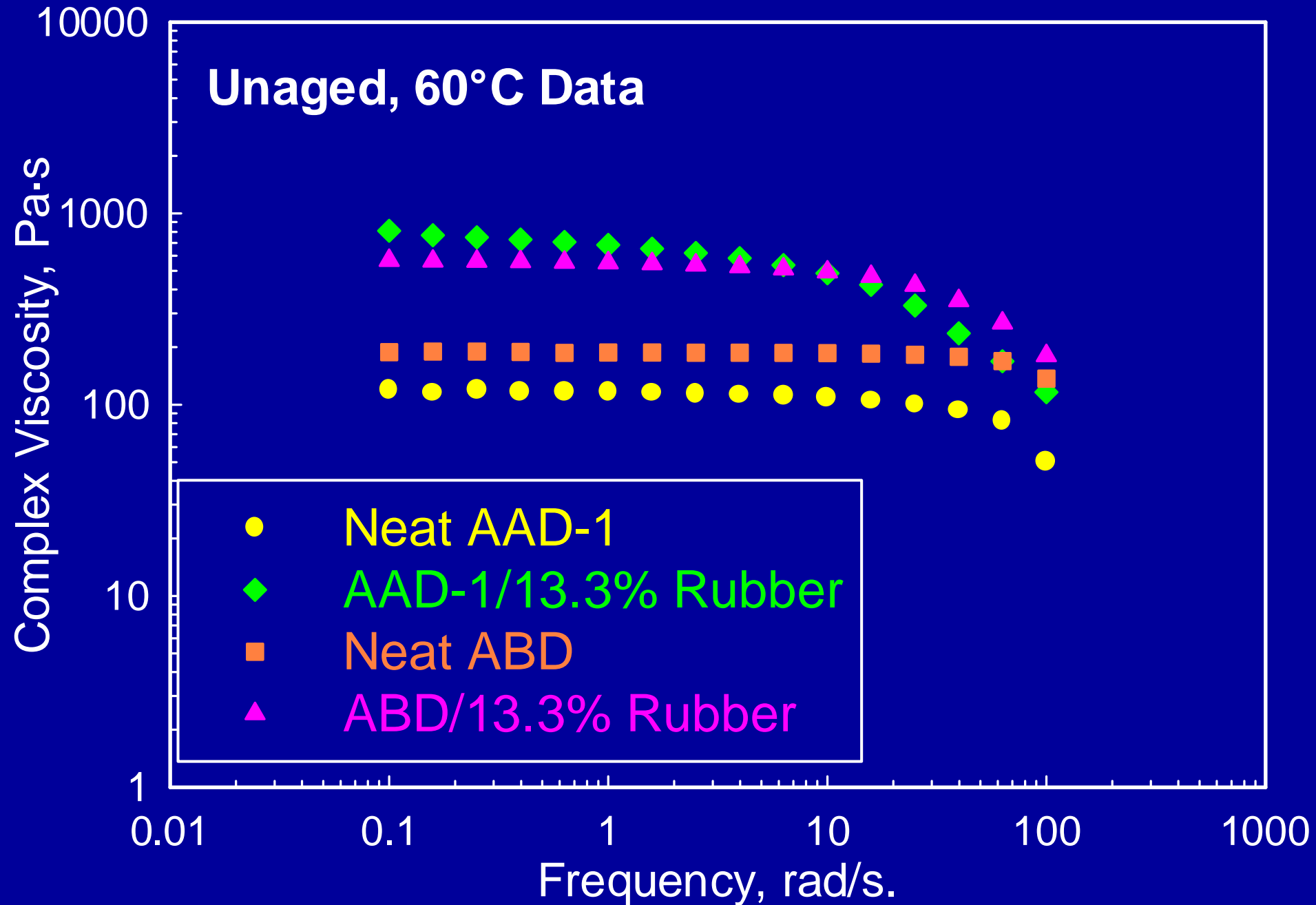
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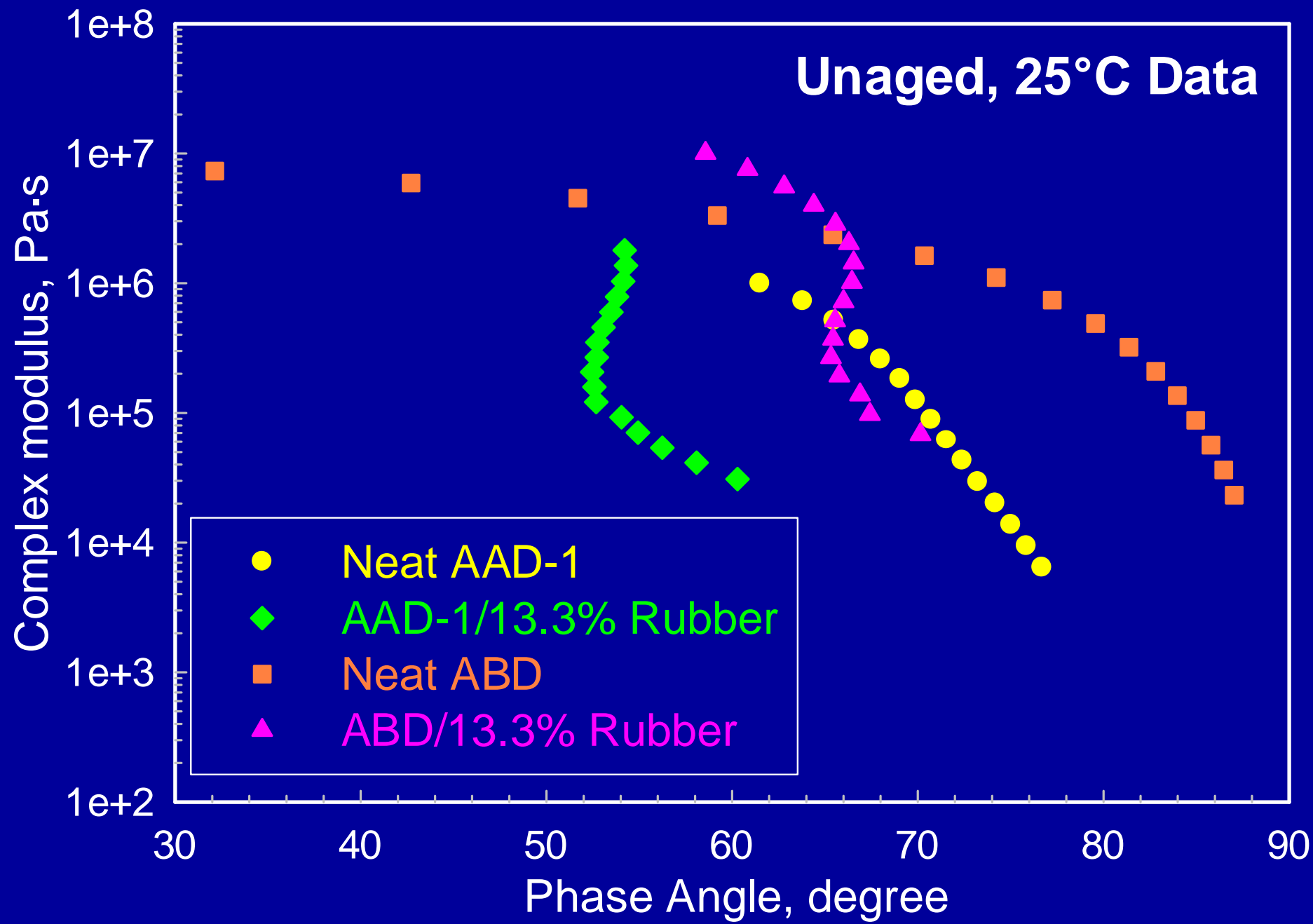
EFFECT OF RUBBER ON SHEAR SUSCEPTIBILITY



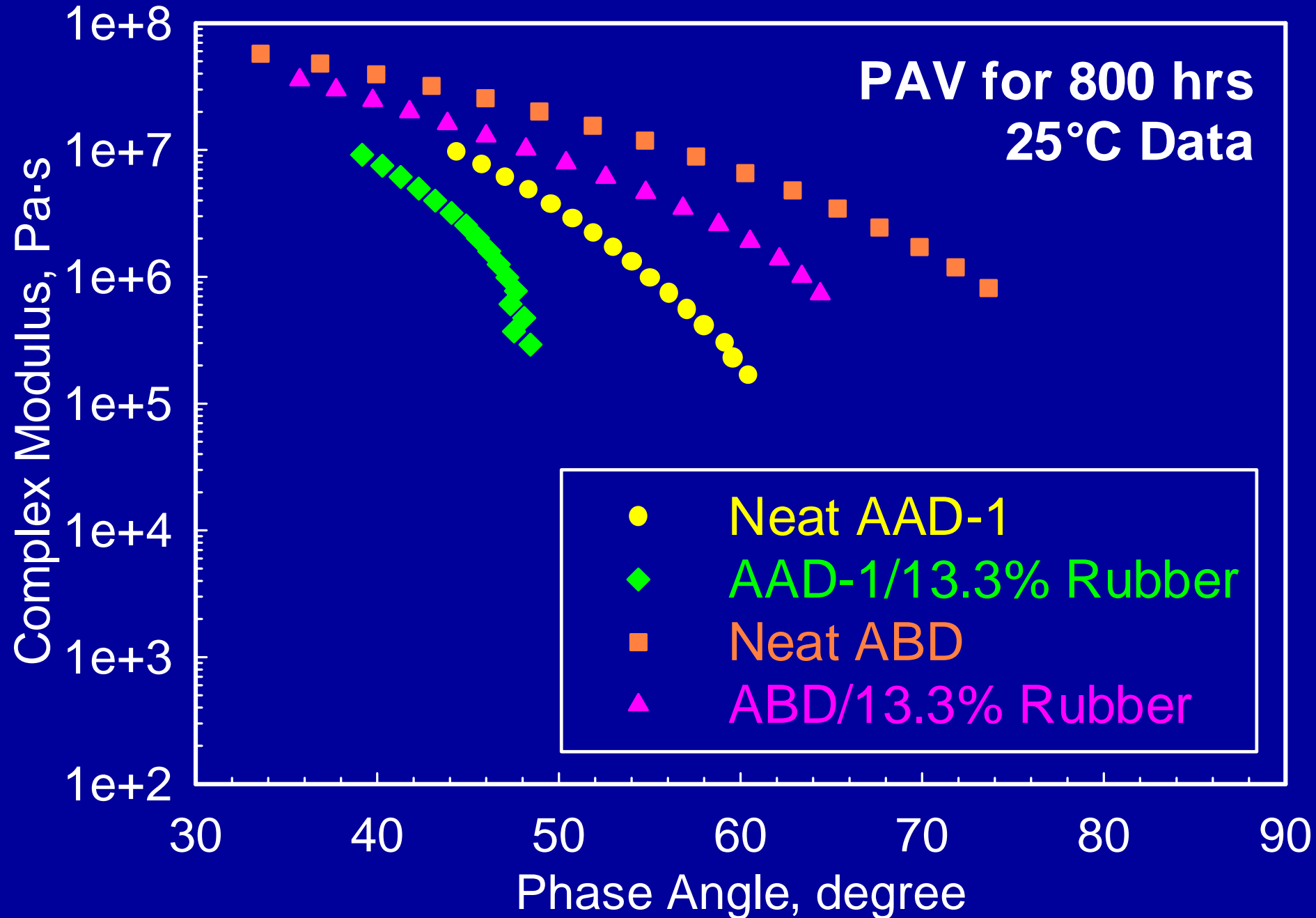
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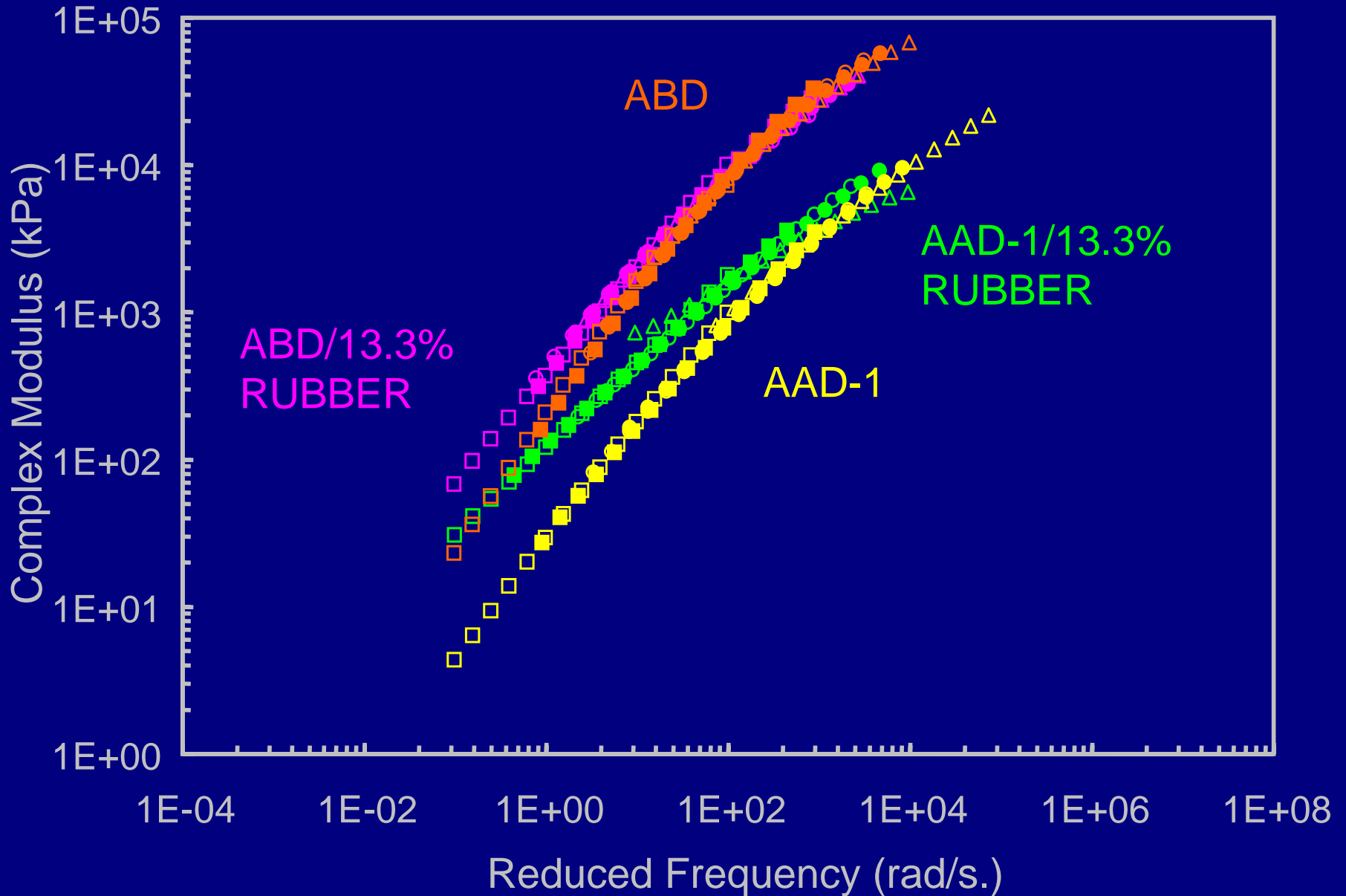
EFFECT OF RUBBER ON BLACK PLOT



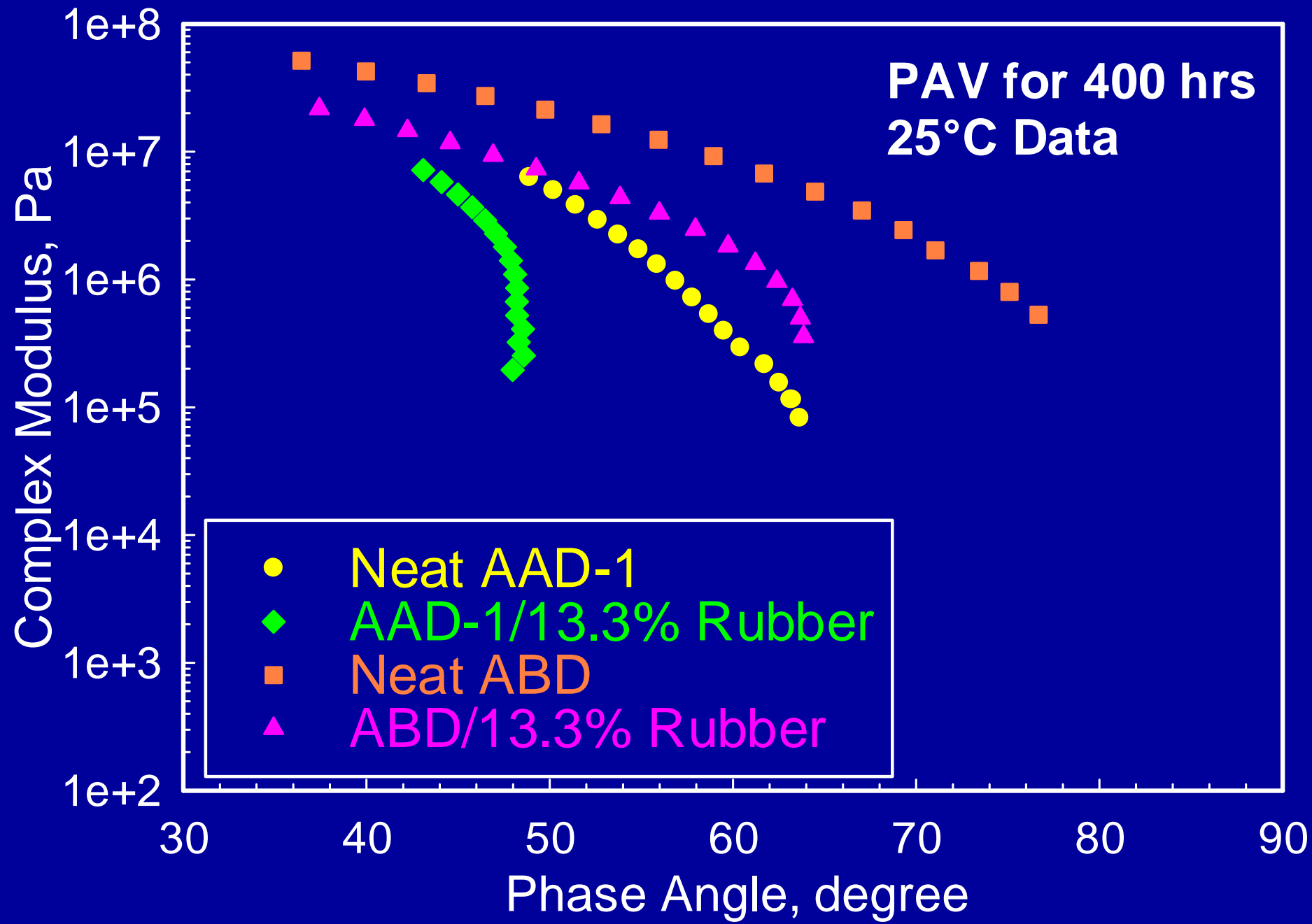
EFFECT OF OXIDATION ON BLACK PLOT



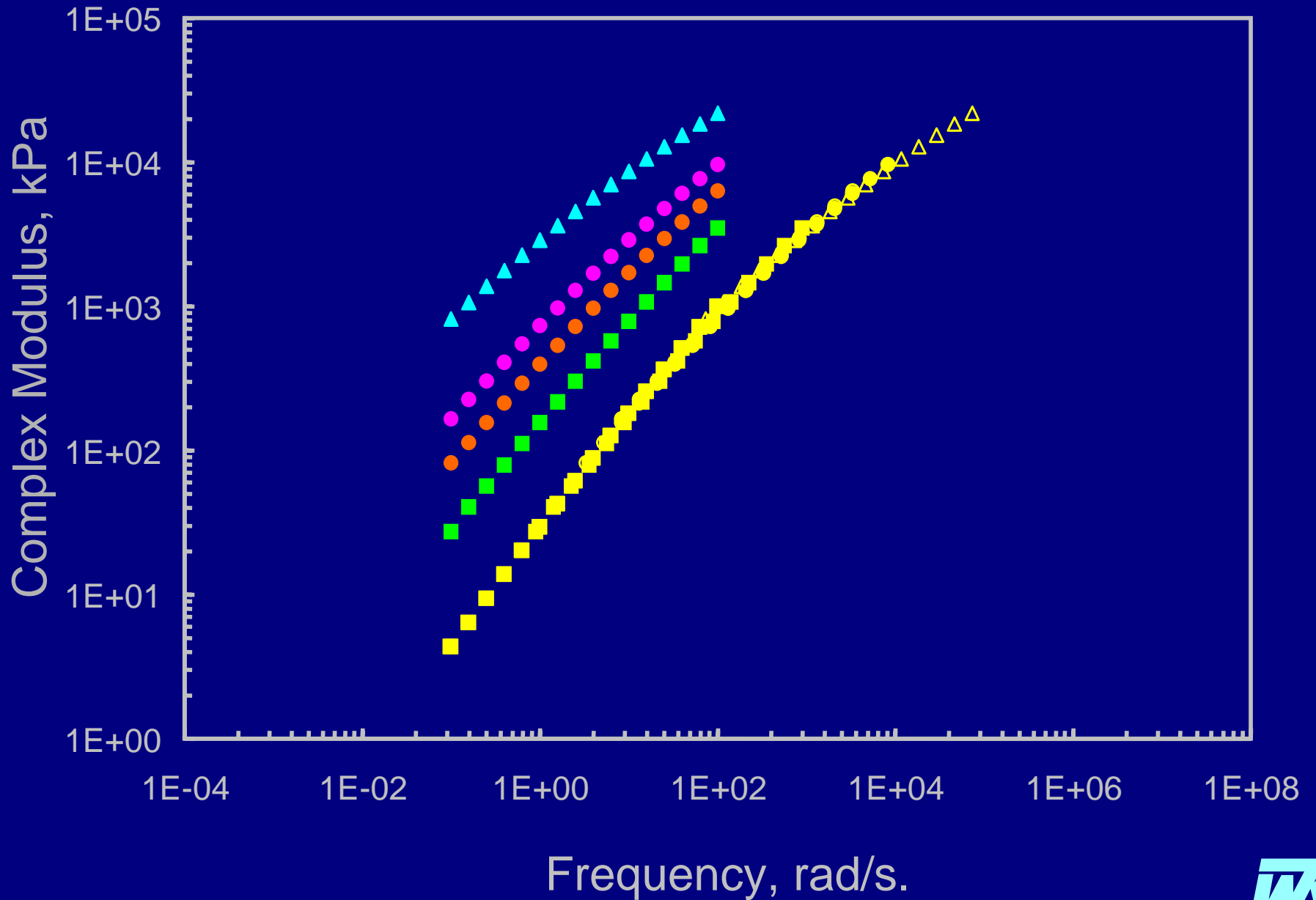
EFFECT OF RUBBER ON MASTER CURVES



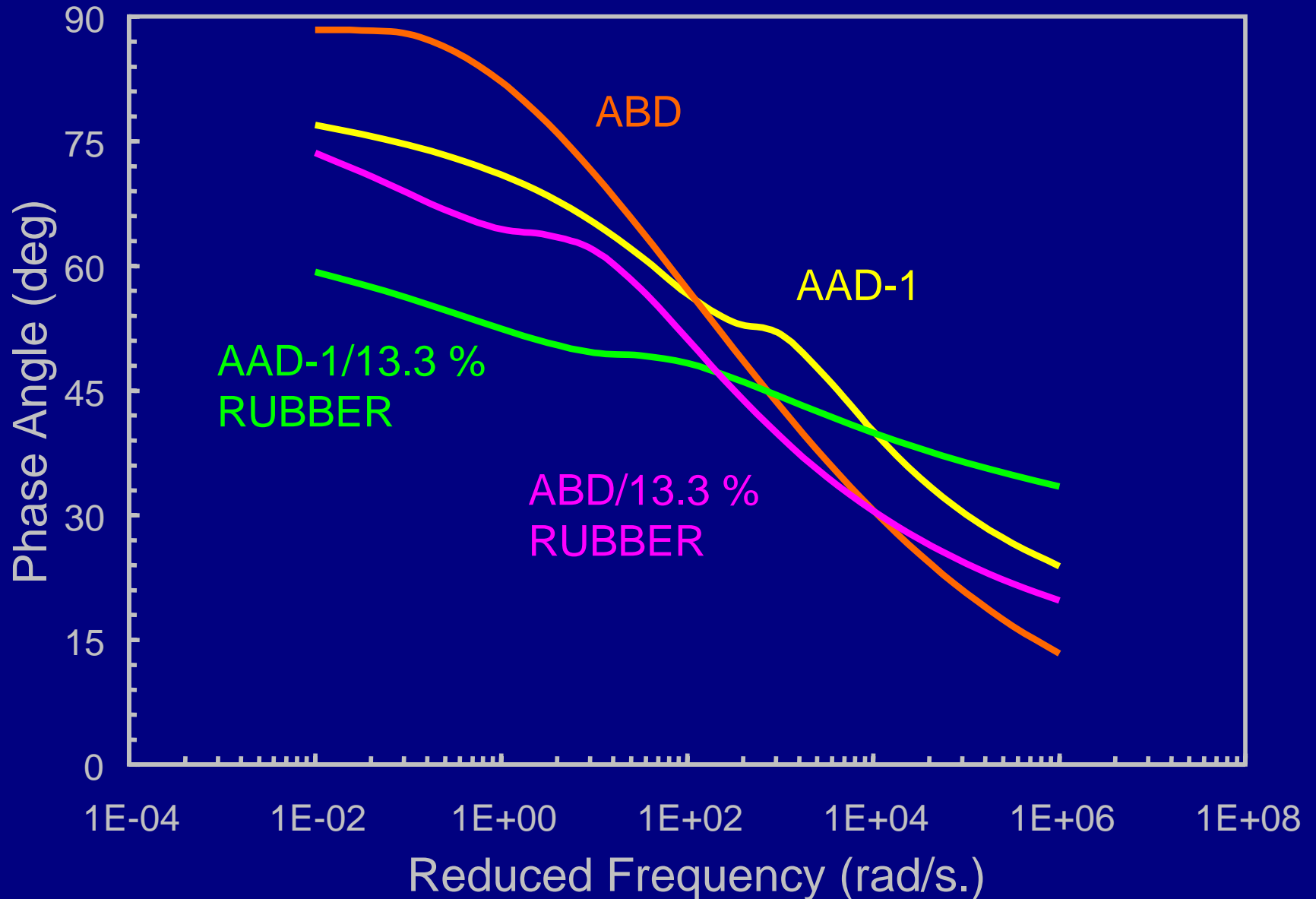
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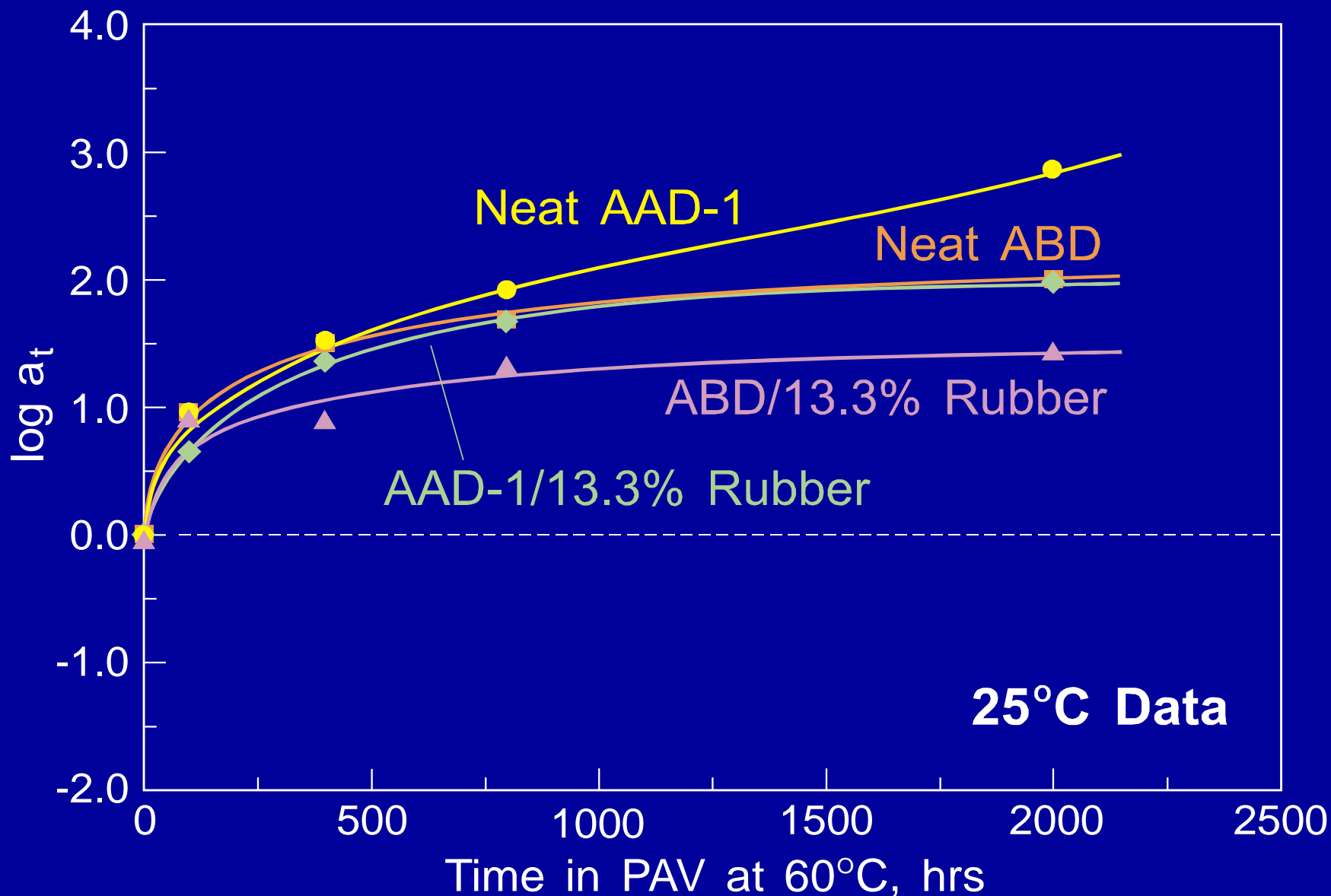
MASTER CURVE OF ASPHALT AAD-1



EFFECT OF RUBBER ON CHANGE IN MASTER CURVES OF PHASE ANGLE



EFFECT OF RUBBER ON SHIFT FACTOR



CONCLUSIONS

- The results indicated that the addition of crumb rubber to asphalt binder increases the binder viscosity and improved the resistance of the binder to aging.
- The obvious benefit of adding crumb rubber to asphalts AAD-1 and ABD is that the rubber imparts greater elasticity to the binder that helps increase fatigue resistance. The pavement is more flexible, thus improving its susceptibility to low-temperature cracking.

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