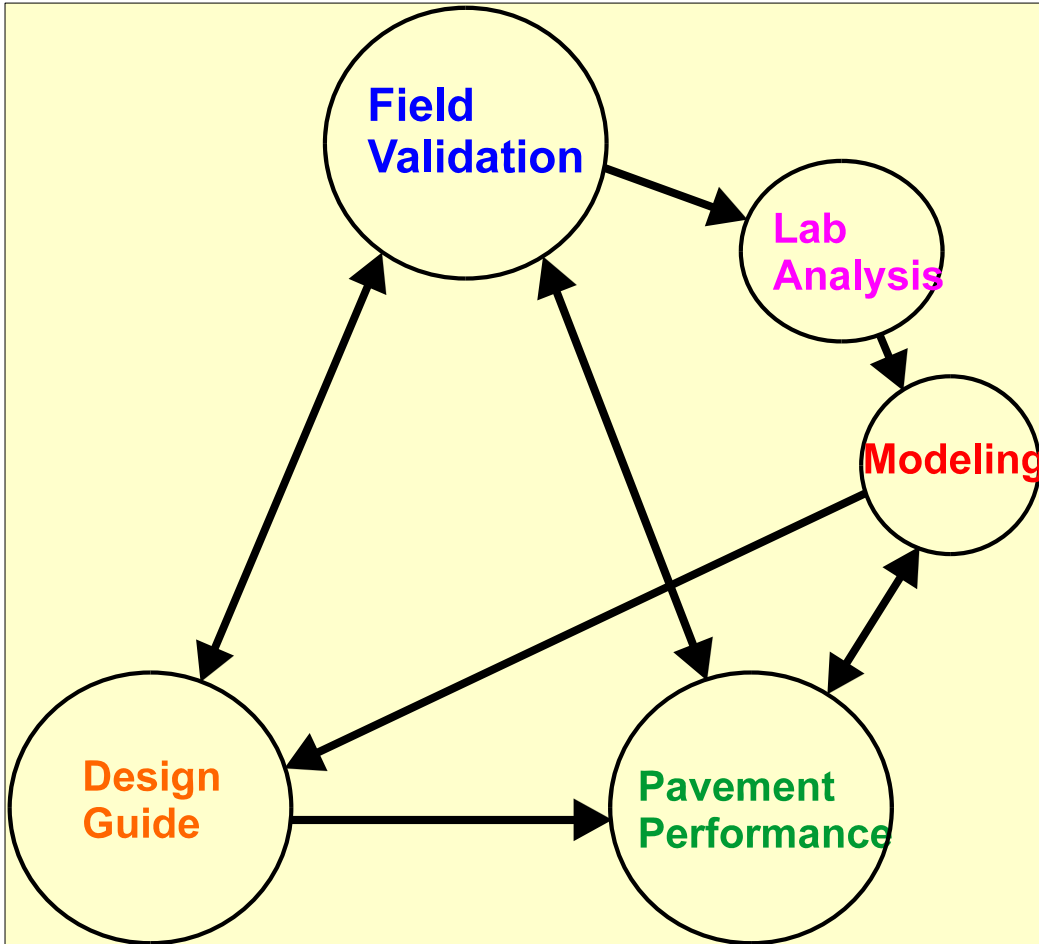


TASK 2-2: ASPHALT AGING

Task Manager: Thomas F. Turner

**Model Expert Task Group Meeting,
Denver, July 23, 2007**

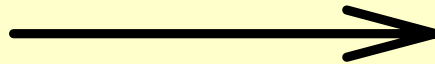
OBJECTIVES



- To aid in the development of the next version of the Mechanistic-Empirical Pavement Design Guide (M-E PDG).
- May lead to a PAV test that requires less time than the current Superpave® method.

FATIGUE CRACKING

Field



Lab

N_f

$N_f \times \text{Shift Factors}$

Shift Factors

Aging

Moisture

Healing

Plastic Gradient

Anisotropy

TASK 2-2.1: ASPHALT AGING IN THE PRESENCE OF WATER

Shin-Che Huang

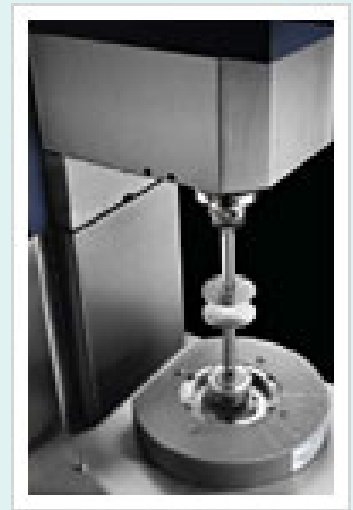
HYPOTHESIS

- The presence of moisture during aging accelerates asphalt oxidation rates by altering the internal structure of the asphalt binder.

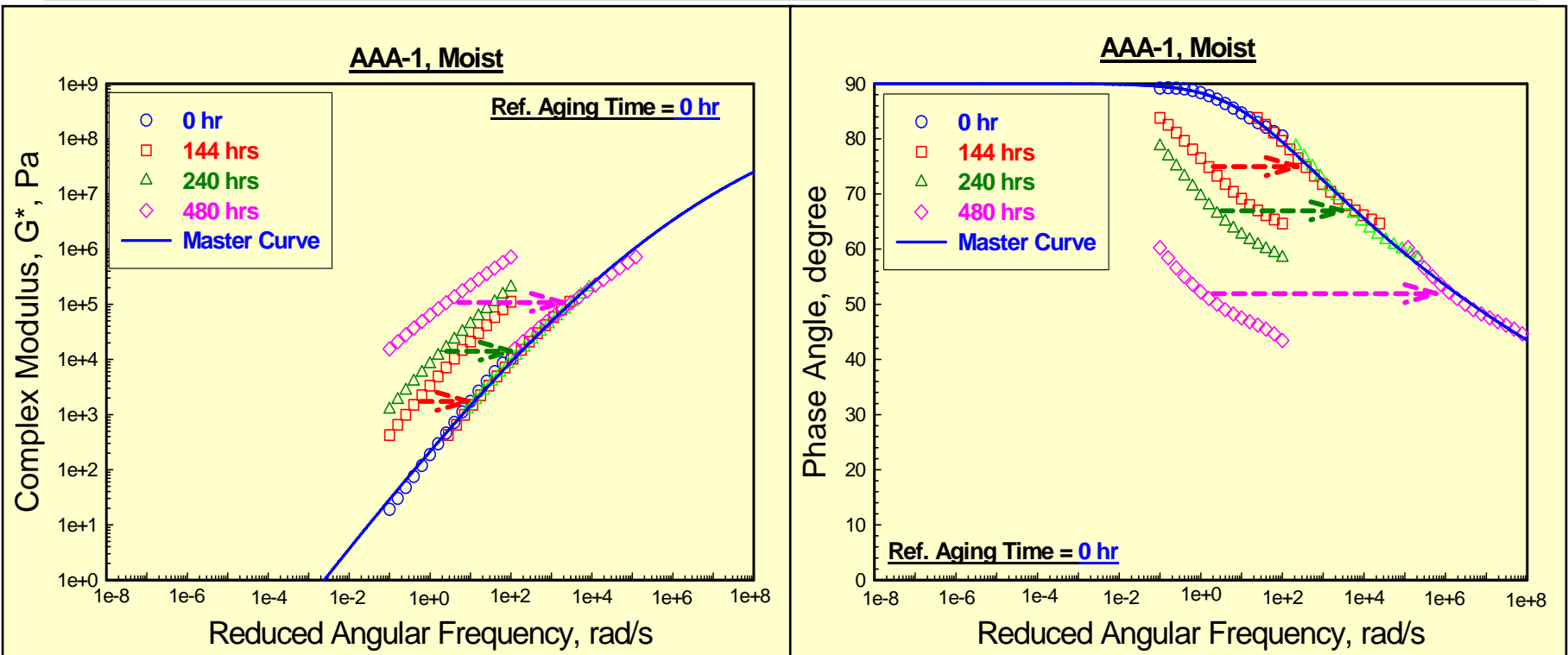


OBJECTIVES

- To evaluate the impact of water on the long-term aging characteristics of asphalt binders.
- To determine if there is correlation between the rheological properties and chemical properties of asphalt binders after long-term oxidative aging.

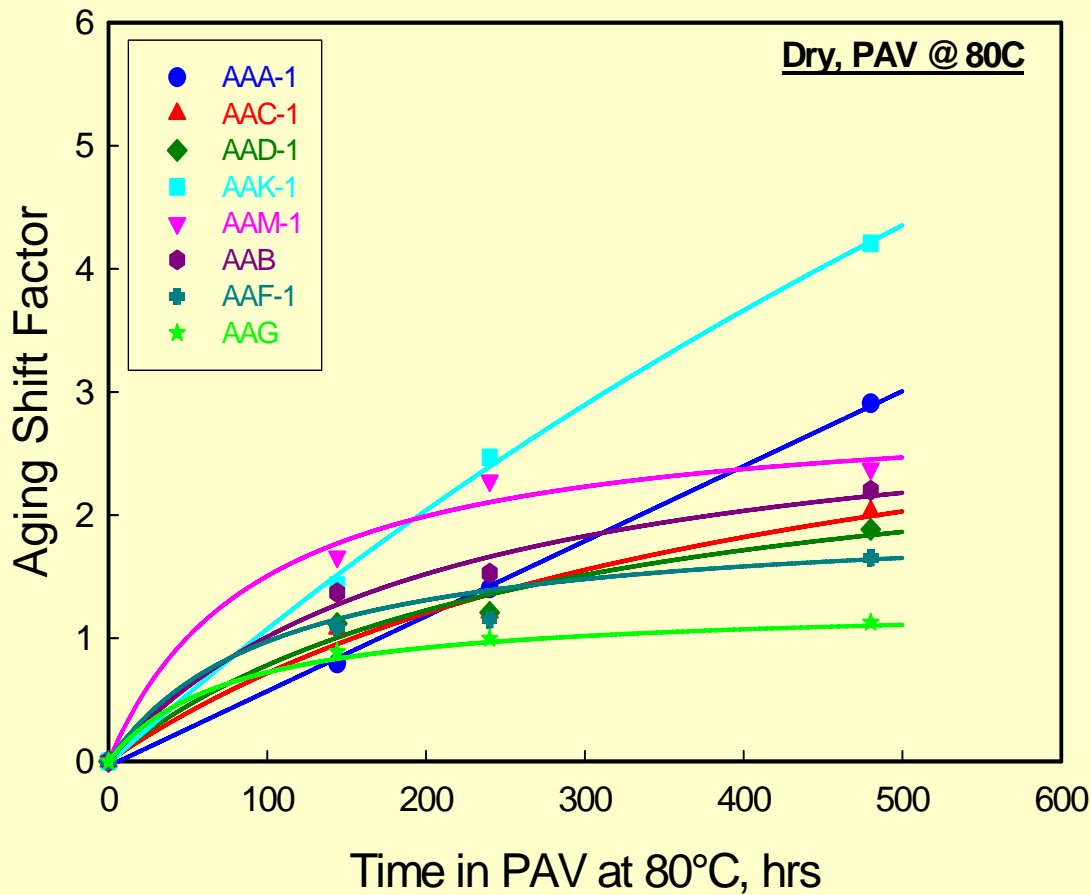


OXIDATION MASTER CURVE



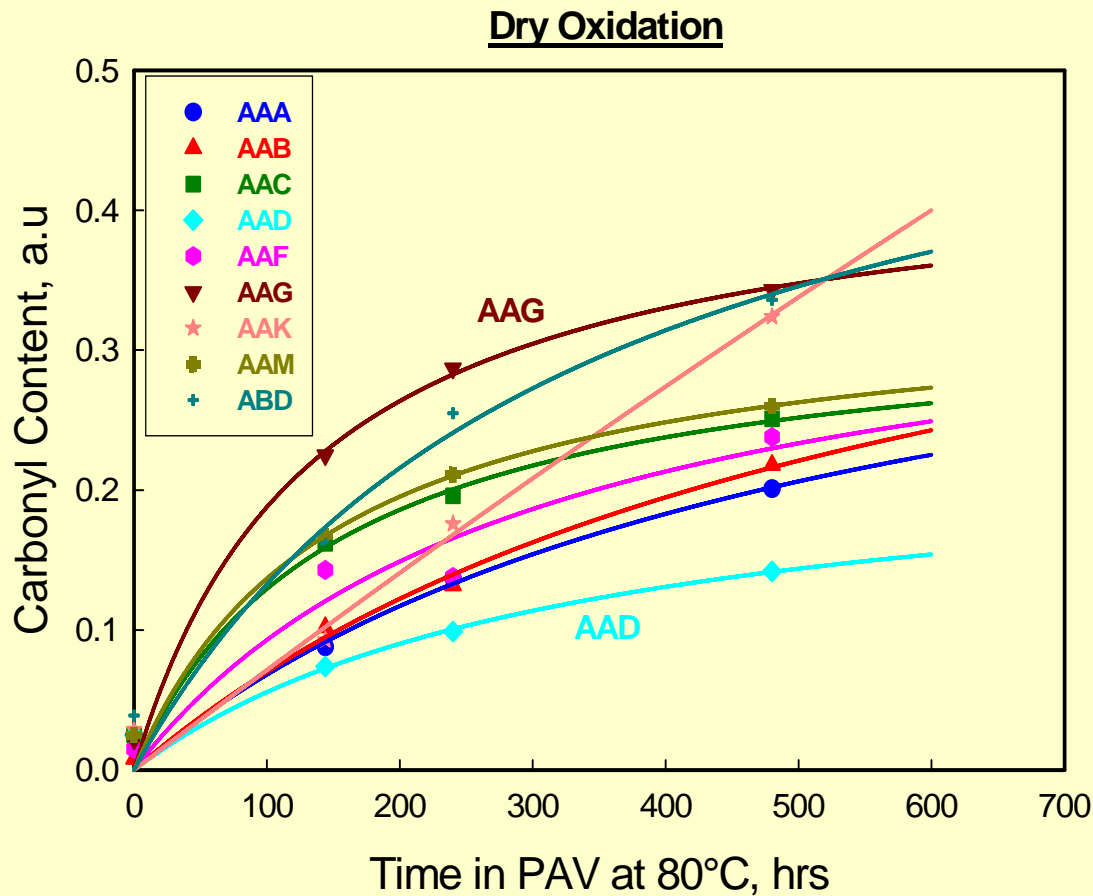
- The **Time-Temperature Superposition Principle (TTSP)** was applied to construct the **Oxidation Master Curves** of rheological parameters for the asphalt binders.

EFFECT OF ASPHALT SOURCE ON AGING CHARACTERISTICS



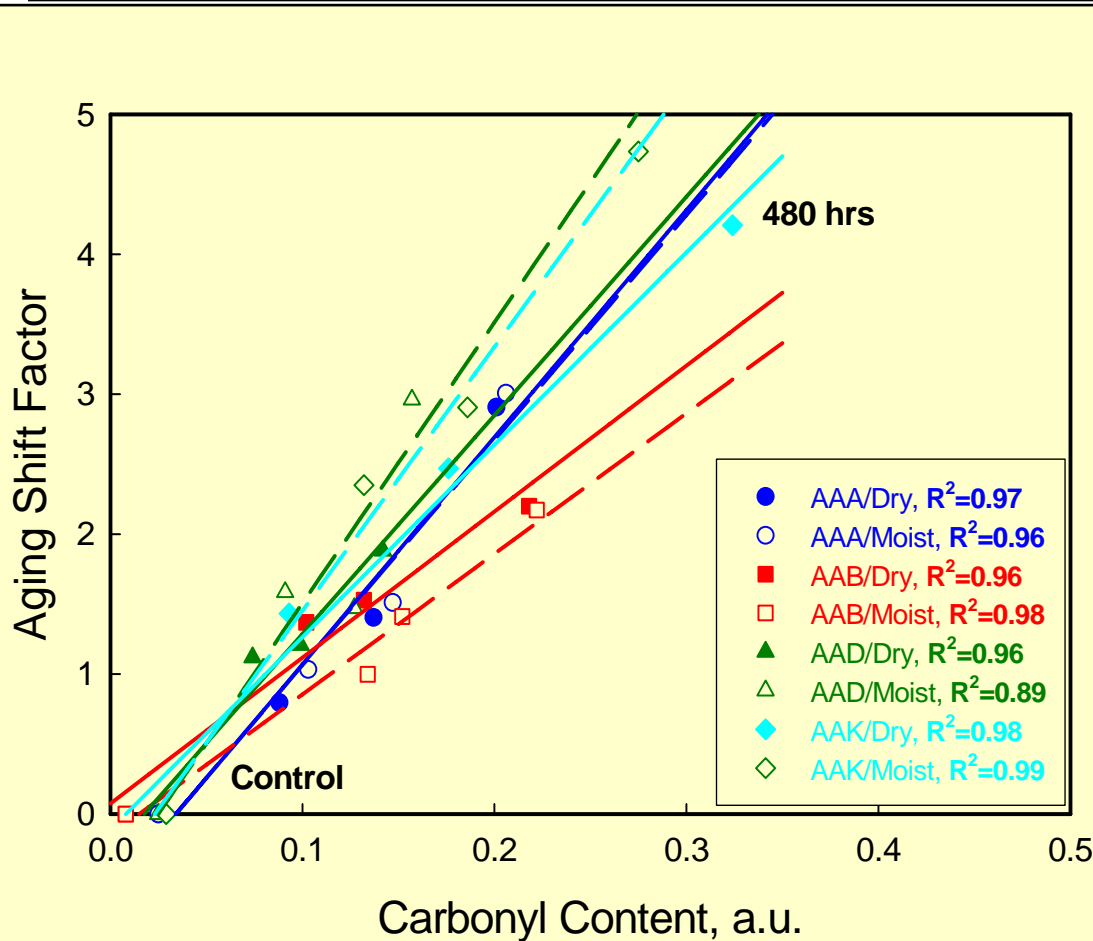
- The **WLF** model was used to construct aging shift factors.
- Asphalts from **different sources** have different aging mechanisms. Some asphalts oxidize **faster** than the others.

EFFECT OF **ASPHALT SOURCE** ON CHANGE OF A CHEMICAL PROPERTY AFTER AGING



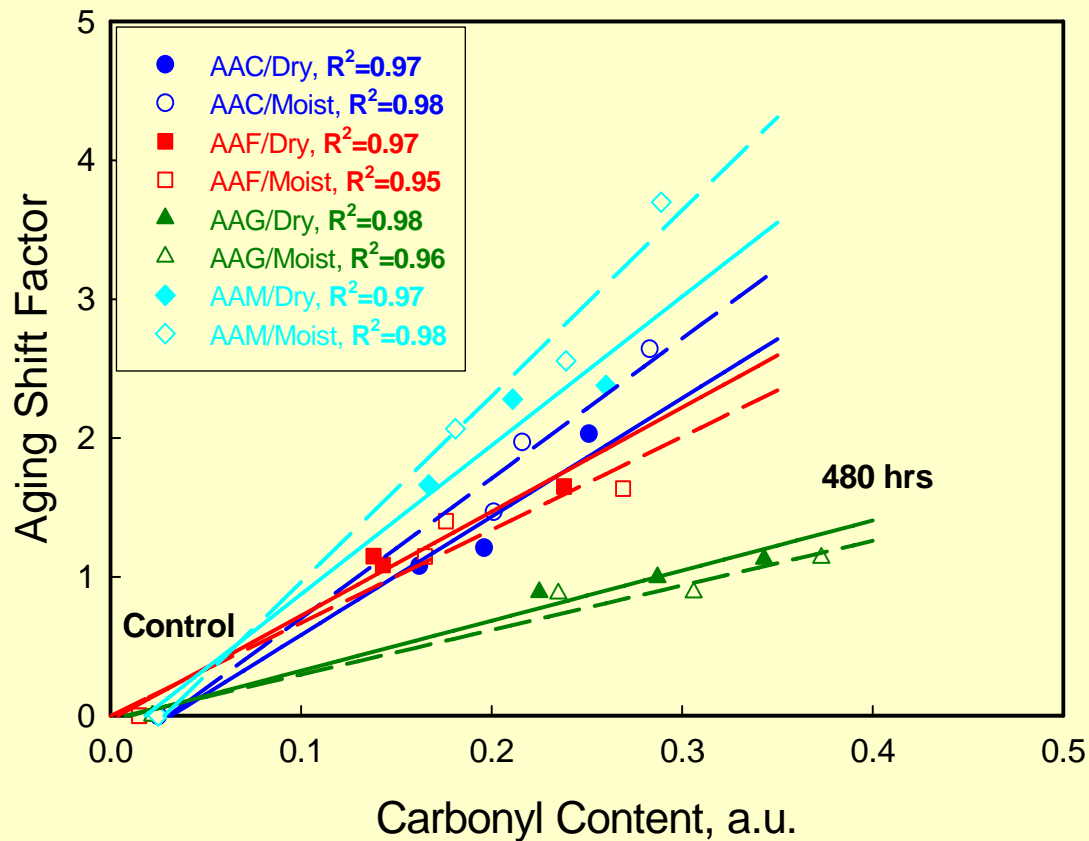
- Asphalts from **different sources** have different effects on the change of carbonyl content after aging.
- Some asphalts oxidize **faster than** others **chemically**.

RELATIONSHIP BETWEEN PHYSICAL AND CHEMICAL PROPERTIES



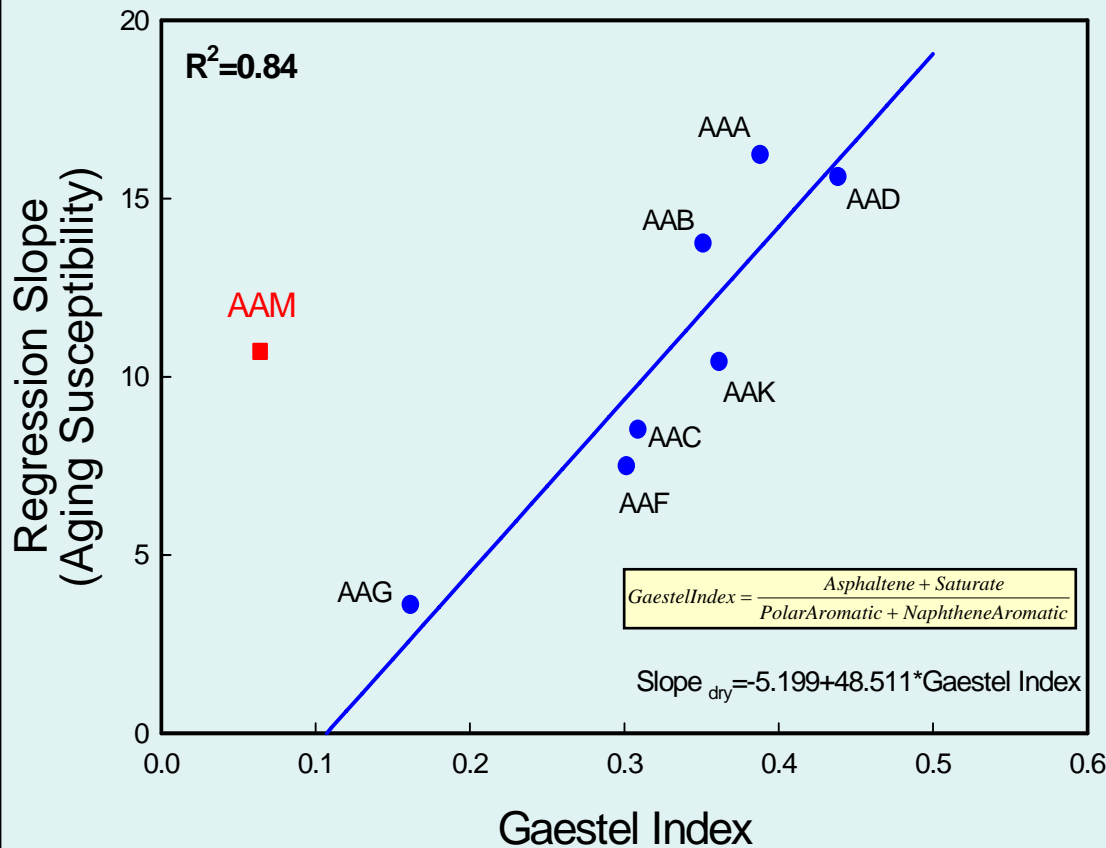
- There is a **linear relationship** between **physical** and **chemical** properties.
- PAV Aging in the presence of **water does not** affect the linear relationship.

RELATIONSHIP BETWEEN PHYSICAL AND CHEMICAL PROPERTIES



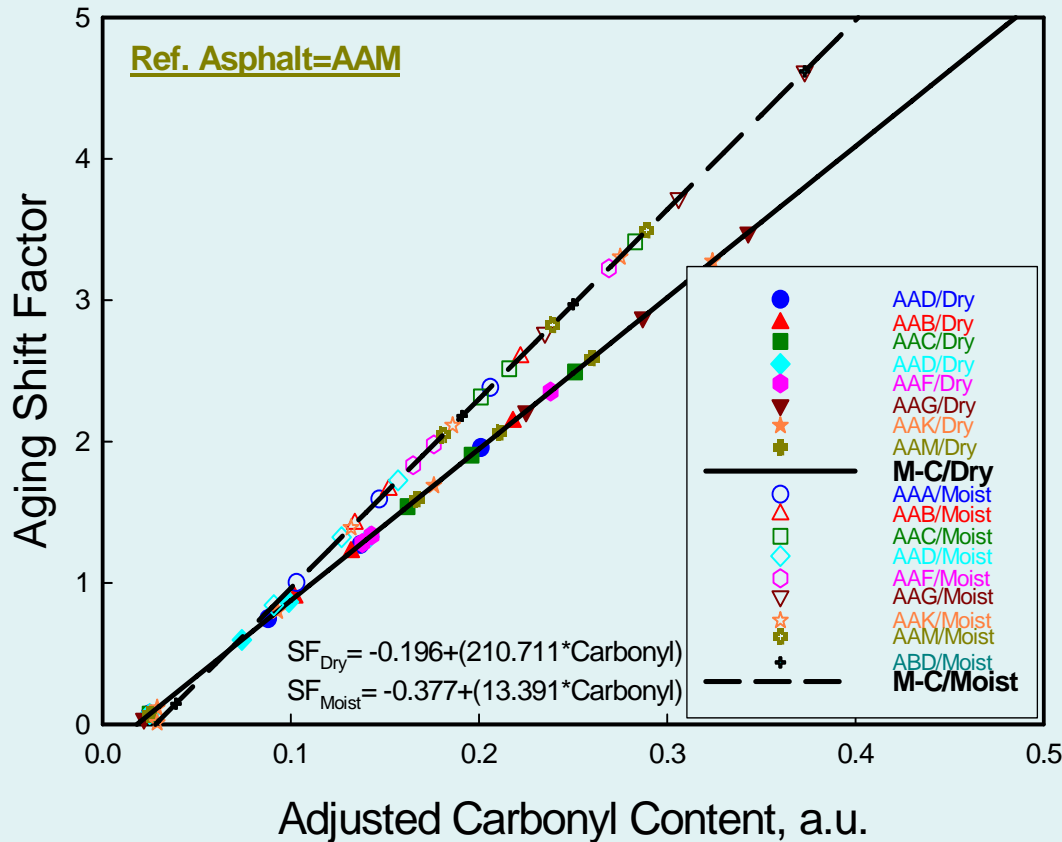
- There is a **linear relationship** between **physical** and **chemical** properties.
- PAV Aging in the presence of **water does not** affect the linear relationship.

RELATIONSHIP BETWEEN AGING SUSCEPTIBILITY AND COMPATIBILITY



- Aging susceptibility is related to material's **compatibility**.
- The **higher** the GI value, the more **gel-type** the asphalt will be and the lower its colloidal stability will be.

RELATIONSHIP BETWEEN PHYSICAL AND CHEMICAL PROPERTY



- There is a **linear relationship** between **physical** and **chemical** properties.
- PAV Aging in the presence of **water** **does not** affect the linear relationship.

SUMMARY

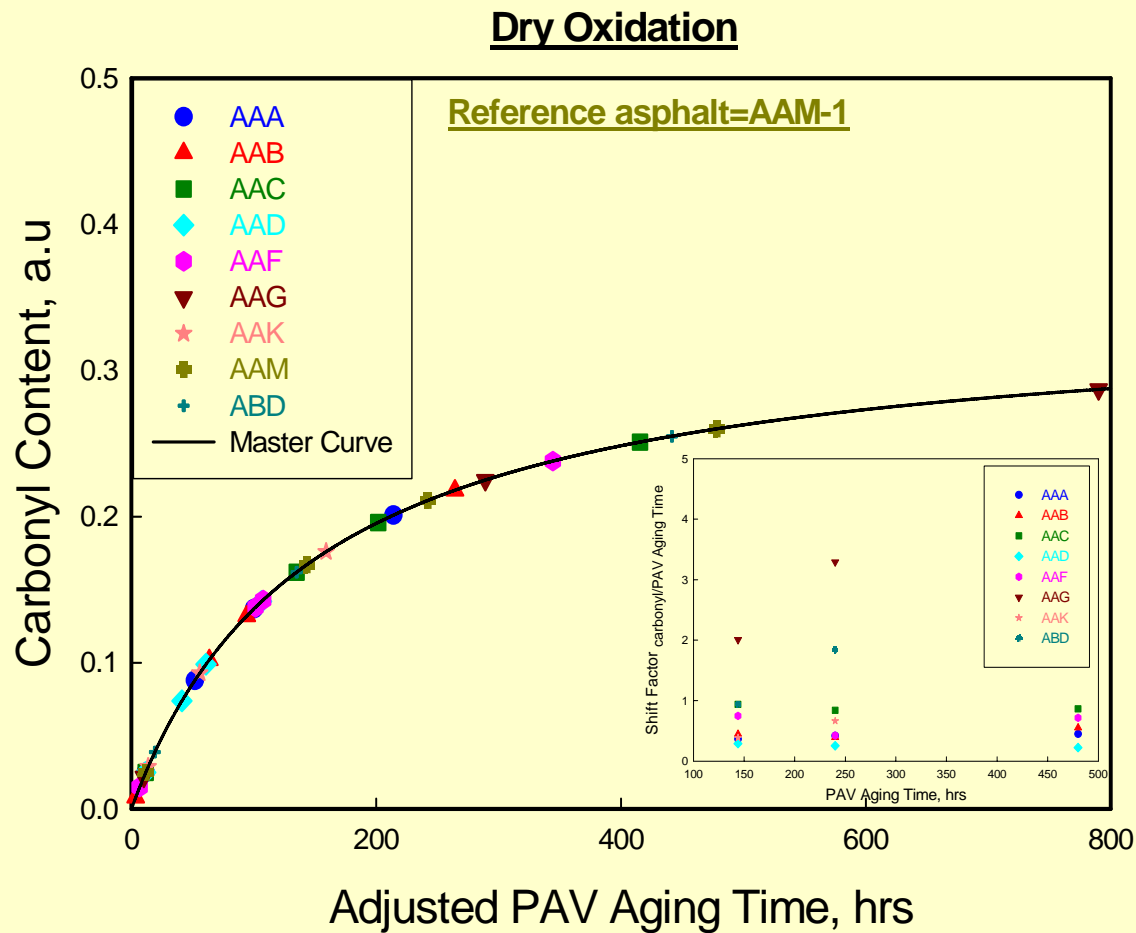
- PAV aging in the presence of **water accelerates** the aging process.
- There is a **linear relationship** between the **physical (aging shift factor)** properties and **chemical (carbonyl content)** properties of asphalt binders. In addition, water **does not** influence the linear relationship.

PROBLEMS???

- R-square is only 0.84. **What** is missing?
 - Aromaticity, molecular weight, wax content, sulfonic acid...?
- Oxidative Aging Kinetic **Master Curve**.
- There is a **linear relationship** between the **physical (aging shift factor)** properties and **chemical (carbonyl content)** properties of asphalt binders in the lab. How about the **Field Validation Sites?**

Comments?

OXIDATION CHEMICAL MASTER CURVE



- It is possible that an **unified curve** of **carbonyl content** can be developed and correlate to **rheological** parameter.