

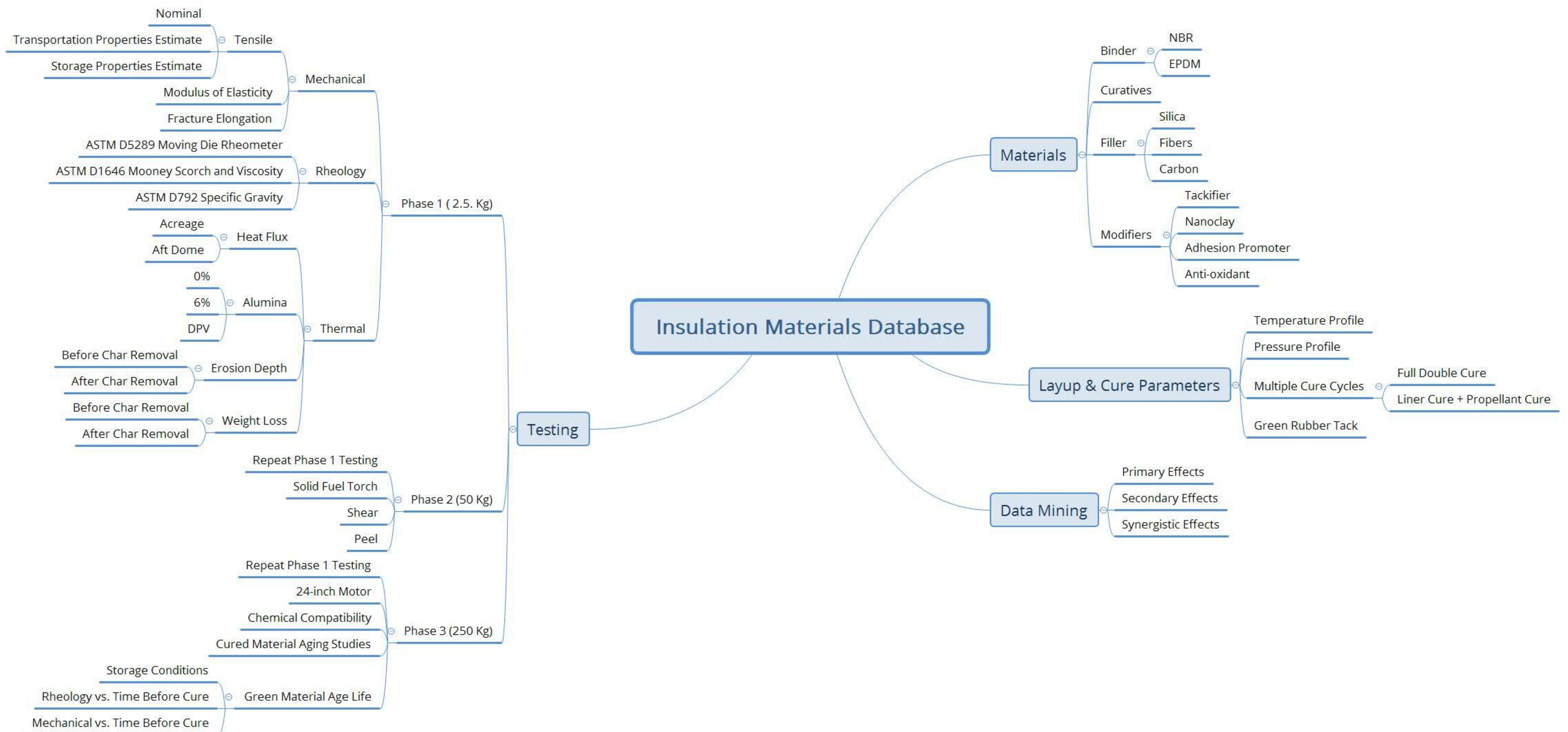
Material Design Database Development for Thermal Insulation



Marshall Space Flight Center

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Insulation Development Framework



Project Overview

As the propulsion center of excellence for NASA, Marshall Space Flight Center has undertaken a systematic study of components and their effects on a set of limited critical properties.

Background

A new solid rocket motor design generally requires force fit of requirements around existing insulation properties.

Insulation replacement based on material obsolescence issues or loss of domestic production often focuses on a drop-in replacement. Opportunity for improved performance and cost savings are lost.

A fundamental understanding of the primary, secondary and synergistic effects of insulation components has lacked designed experiment support.

Methodology

- A current, well understood NBR based insulation formula was chosen as a baseline.
- The technical community is continually polled for component suggestions.
- Three 2.5 Kg mixes of each formula are combined on a hot mill to make a single batch.
- The mix procedure may be adjusted to assure that components are integrated into the material evenly.
- The batch is divided for testing with portions calendared into sheets as required.
- Mechanical and thermal test samples are cured using a standard pressure/temperature cycle in an autoclave for phase 1 work. Alternate cure studies may be undertaken in later phases of testing.
- Thermal and mechanical testing is all performed in house. Rheology testing is performed by a contractor.
- Test data is submitted for statistical study

Results

- 110 formula variations have completed phase 1 testing with 30 more in work.
- Primary effects of constituent and process changes have been identified.
- 3 formulations are in phase 2 testing
- 2 formulations are in phase 3 testing
- Secondary and synergistic effects are under analysis.

Moving Forward

- We continue to identify new components to be incorporated in test formulas.
- Incorporating a new thermal test bed that can match pressure, temperature and chemistry for a specific motor design to aid evaluation.
- Evaluate equilibrium thermal properties.
- Seeking additional technical partners.