

## Phosphoric Acid as an Asphalt Modifier Guidelines for Use: Acid Type

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### Selection of Acid Type

Any grade of phosphoric acid can be used as an asphalt modifier. The stiffening effect is asphalt dependent. All grades of acid will yield similar results. However, the more diluted grades contain water, which may result in foaming problems as the water boils when the acid is added to hot asphalt. The use of crude *green acid* is not recommended as it contains acid impurities that are likely to cause corrosion of equipment.

### Background on Phosphoric Acid

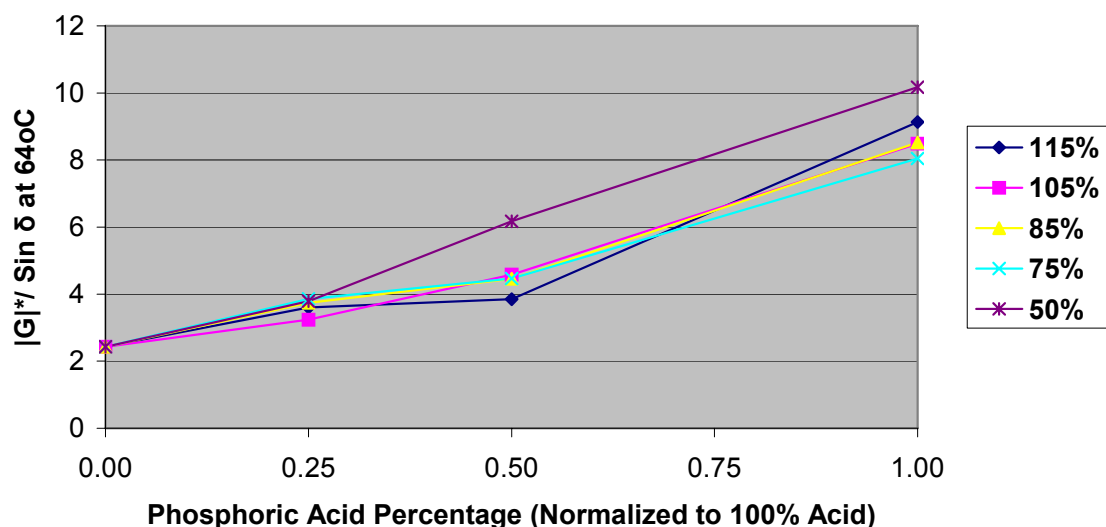
Phosphoric acid is produced commercially by two methods: wet process and thermal process. In the wet process, ground phosphate rock is digested with sulfuric acid to produce a crude *green acid*, which contains strongly acidic impurities, mainly sulfuric and hydrofluoric acids. In the thermal process, yellow phosphorous is burned in air to give phosphorous pentoxide, which is further reacted with dilute phosphoric acid to produce to strong phosphoric acid. Further purification steps in both processes yield several grades of very pure phosphoric acid.

Different grades of phosphoric acid containing different amounts of orthophosphoric acid are commercially available. They contain 50, 75, 85 and 100 percent of orthophosphoric acid. Two other grades Superphosphoric and Polyphosphoric acids contain 105 and 115 percent of orthophosphoric acid and are mixtures of pyrophosphoric acid, triphosphoric and higher acids.

### Experimental Validation

The stiffening effect of different phosphoric acid grades was determined by modifying four reference asphalts from the Strategic Highway Research Program (SHRP) by measuring different amounts of each acid grade and determining the stiffness ( $|G|^*/\text{Sin } \delta$  at 64 °C) using a dynamic shear rheometer. An example, shown in the following chart of stiffness of Boscan asphalt (AAK-1) plotted against the amount of acid modification shows the same slope for each grade of acid.

Stiffness of AAK-1 Modified with Phosphoric Acid



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FHWA-HRT-08-061  
HRDI-11/05-08(Web)E