Phosphate Forum of the Americas

Uses & Applications of Phosphates in Asphalt Modification

Asphalt is one of the most widely used materials for road construction. According to the Asphalt Institute, around 95% of all roads in the United States are made of asphalt binders. One of the most important and challenging tasks of the asphalt industry is to develop stronger and more durable pavements which are able to withstand high volume traffic, continuous increase in the traffic flow as well as variations in climate. Therefore, more focus has been put on research in transport related areas in the last several years, including new and improved road materials. At the moment significant research and development efforts in asphalt technologies is taking place worldwide. One of the most developed technologies is the application of modified bitumens. Modified bituminous materials can bring real benefits to highway maintenance/construction in terms of better and longer lasting roads and savings in total road life cost. Typical modifiers include polymers, chemical additives, or a combination of the two.

Polyphosphoric acid (PPA) is a chemical modifier and has been used for this purpose in North America for over thirty years. Typical dosage of PPA ranges between 0.25 wt% and 1.0 wt% (based on the weight of the binder). An estimated 100 to 400 million tons of asphalt mix that has been modified with PPA have been utilized on U.S. highways in the recent years.

In the U.S., PPA is used in various applications which involve preparation of paving or roofing grade bitumens. These applications involve direct modification of bitumen binder with PPA, preparation of PPA-modified binders in combination with SBS (spell out?) polymers, the application of PPA as a catalyst in preparation of bitumen modified with reactive terpolymers, and as an accelerator during air-blowing process. In neat paving bitumen, PPA increases the high-temperature Performance Grade (PG) rating of the bitumen while maintaining the low-temperature properties. Significant improvements in the water-sensitivity of mixes are also obtained. In polymer-modified bitumen, the use of PPA provides these same benefits and also allows for a significant reduction in the level of polymer required to meet elastic recovery requirements. The mechanism by which PPA interacts with bitumen to improve its rheology and overall properties is still under investigation. One theory that has been put forward suggests that PPA reacts with various organic functional groups in bitumen breaking up asphaltene agglomerates and allowing the individual asphaltene units to form a better dispersion in the maltene phase. The dispersed individual asphaltene units are relatively more effective in forming long-range networks and in turn contribute to elastic behavior, Figure 1.

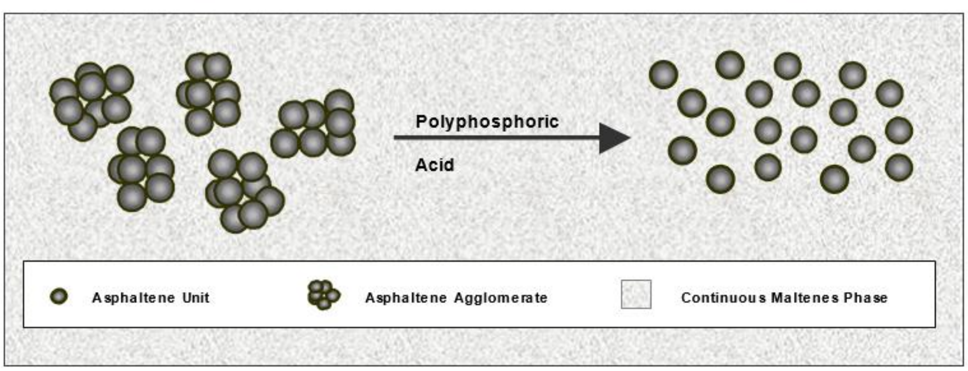

Figure 1. Possible Mode of Action of Polyphosphoric Acid in Asphalt Modification

529 14th Street NW, Suite 1280, Washington, DC 20045 1.202.591.2438