Bone Glue Modified Asphalt Binders

**Background:** In the pavement industry, polymer modified asphalts (PMA) are used frequently in almost every part of the world, especially in developed countries. PMA exhibits better performance but requires high temperatures (150°C to 210°C) and extended mixing time (60 to 200 min) to develop homogenous blends. Furthermore, the mixing and compaction temperatures of hot mix asphalt (HMA) mixtures made with PMA are much higher than the conventional mixtures. The higher initial cost of modified asphalts in terms of material, energy, processing, and construction, limits its use in developing countries and in parts of developed countries. A viable option would be a cheaper modifier, bearing low cost of modification and exhibiting improvement in mechanistic and performance characteristics of asphalt binder.

**Innovation:** To meet this need we have developed “Bone Glue” (BG) modified asphalts which utilizes BG, a by-product of food and cattle industries. BG is protein-based glue made from collagen extracted from animal bones, hides and flesh waste and is widely commercially available. It is adhesive in nature and can be blended with asphalt at low temperatures without significantly changing mixing /compaction temperatures of HMA mixtures, thus making it an energy efficient binder. Further, we have developed optimized mixing and processing methods for BG modified asphalt. Our BG modified asphalt binder is cost-effective and exhibits superior rheological and mechanistic properties. *Rizvi, Khattak & Gallo. Construction and Building Materials 2015.*

**Table 1: Mixing & Compaction Temperatures (°C)**

<table>
<thead>
<tr>
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<th>Neat Asphalt</th>
<th>BG Modified Asphalt</th>
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<tbody>
<tr>
<td>Mixing</td>
<td>144-147</td>
<td>149-154</td>
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<tr>
<td>Compaction</td>
<td>136-140</td>
<td>140-146</td>
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**KEY ASPECTS OF THE TECHNOLOGY:**

- The viscosity of BG modified asphalts is nearly identical to control asphalt binder;
- Mixing and compaction temperatures of BG modified asphalts are nearly identical to control asphalts (above chart);
- BG modified asphalt exhibits significantly improved (50%) dynamic shear modulus (G*) especially at lower frequencies (bottom right figure);
- Dynamic shear fatigue results demonstrates a significant improvement in fatigue life (top right figure);
- Creep compliance value for BG modified asphalt was also superior to that of the neat asphalts;
- Based on a UL Lafayette patent-pending technology.