2. Hierarchical structure of high-structured carbon blacks

<table>
<thead>
<tr>
<th>Carbon black type</th>
<th>Suspending fluid</th>
<th>(\phi_{\text{eff}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulcan XC-72</td>
<td>Propylene carbonate</td>
<td>0.12, 0.20, 0.27</td>
</tr>
<tr>
<td>Vulcan XC-72</td>
<td>Light mineral oil</td>
<td>0.12, 0.20, 0.27</td>
</tr>
<tr>
<td>KetjenBlack EC-600JD</td>
<td>Light mineral oil</td>
<td>0.20, 0.27</td>
</tr>
</tbody>
</table>

Higher order structures: dependent on shear, \(\phi\), interactions, etc.

Basic building blocks: independent of shear and \(\phi\)

3. Structural transition across \(B'i^1 = 1\) for all suspensions

A bifurcation in agglomerate structure is measured around \(B'i^1 = 1\). This structural change is evident in the rheology.

\[ B'i^1 = \frac{\sigma}{\sigma_{\text{app}}} \]

\(B'i^1 < 1\) \(\rightarrow\) \(\sigma < \sigma_{\text{app}}\)

\(B'i^1 > 1\) \(\rightarrow\) \(\sigma > \sigma_{\text{app}}\)

Evidence of structure transition after 300 s

5. Agglomerate breakup depends on the Mason number

At \(B'i^1 > 1\), Rheo-USANS measurements are used to quantify the effect of shear on agglomerate size, \(R_g\), and fractal dimension, \(D_f\). These results show that agglomerates break up self-similarly with increasing shear rate. The extent of this breakup is a complex function of \(\phi_{\text{eff}}\), suspending fluid, carbon black type, and interaction potential.

6. Conclusions

General behaviors observed:
- The inverse Bingham number, \(B'i^1\), predicts a transformation in agglomerate structure.
- Agglomerates breakup self-similarly at \(B'i^1 > 1\).
- At \(B'i^1 > 1\), the breakup of agglomerates depends on the Mason number, \(M_n\).

Questions? Contact me at jhipp@udel.edu

7. Acknowledgements

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8. References