EXPERIMENTAL INVESTIGATION OF DISPERSION DURING FLOW OF MULTI-WALLED CARBON NANOTUBE/POLYMER SUSPENSION IN FIBROUS POROUS MEDIA

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IDEA AND THE CHALLENGES

Typical carbon nanotubes (CNT) properties:
- Diameter 10~15nm
- Length 10~20 μm
- Young's Modulus > 1TPa
- Tensile Strength > 200GPa
- Aspect ratio ~ 1000

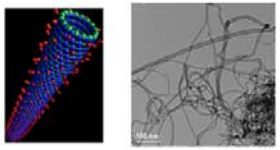

Figure 1)TEM of CNT

Introduce the Multiwalled Carbon Nanotube (MCNT) into the glass fiber reinforced composite to make better multifunctional composites.

Challenges:

1. Because MCNTs are in the nano-scale and inert with most solvents, they are easy to entangle together and difficult to be dispersed into polymer suspension.
2. The glass fiber porous media will affect the dispersion of the MCNT during flowing through the media.

EXPERIMENTAL PROCEDURE

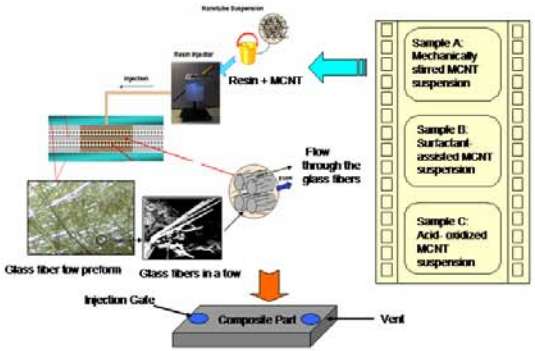

Figure 2) Flow chart depicting the procedure for the preparation of the composite samples containing Vinyl ester/glass fibers and MCNT.

THE DISPERSION OF THE MCNT IN THE 3% WT MCNT/VINYL ESTER COMPOSITE WITHOUT ANY CHEMICAL METHODS

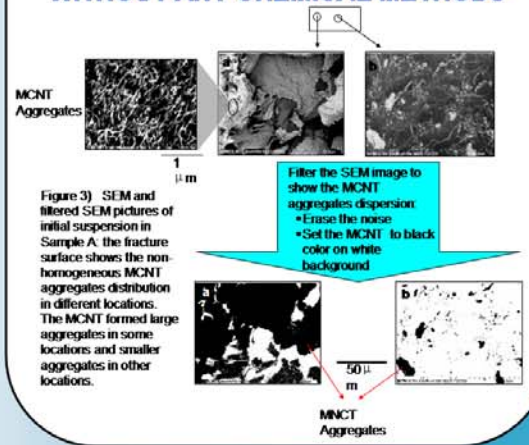

Figure 3) SEM and filtered SEM pictures of initial suspension in Sample A: the fracture surface shows the non-homogeneous MCNT aggregates distribution in different locations. The MCNT formed large aggregates in some locations and smaller aggregates in other locations.

MCNT DISPERSION IN THE 3% WT MCNT/VINYL ESTER USING SURFACTANT

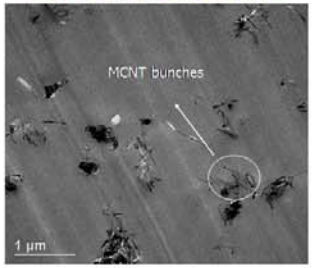

Figure (4) Filtered SEM and TEM pictures of the Sample B 3% MCNT/Vinyl ester. The MCNT aggregates sizes have been decreased and the distribution of these aggregates is more uniform than sample A.

MCNT DISPERSION OF THE 3% WT MCNT/VINYL ESTER USING OXIDIZED MCNT

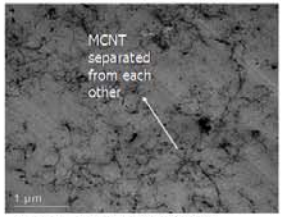

Figure 5) TEM picture of the initial suspension in sample C (3% MCNT/Vinyl ester): shows the oxidized MCNTs are not entangled.

MCNT DISPERSION AFFECTED BY GLASS FIBER POROUS MEDIA

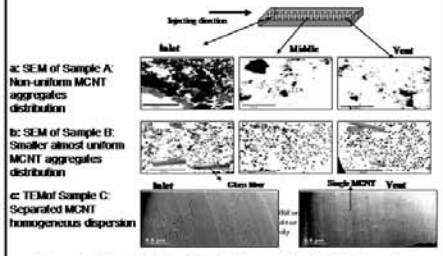

Figure 6) Filtered SEM and TEM pictures of the MCNT dispersion (dark regions in the SEM pictures) at the injection gate, in the middle and at the vent.
a. Sample A (mechanically stirred).
b. Sample B contains the surfactant.
c. Sample C contains oxidized nanotubes.

CONCLUSIONS

1. The glass mat acted as a possible shear force to break down the average aggregate size but at the same time it also introduced a filtering effect when the MCNT aggregates were bigger than 100μm.
2. In the case of the uniform MCNT/Vinyl ester dispersion (suspensions B and C), the glass fiber almost had no filtering effect on the suspensions.
3. Only in the case of homogenously dispersed and separated MCNT (suspension C), the nano-scale gaps between glass fibers were filled MCNT.

ACKNOWLEDGEMENTS

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