SUMMARY

The phenomenon of enhancing the electrical conductivity of the plastic by incorporating metallic filler has numerous potential applications. Many of the commercial applications also requires the knowledge of ultrasonic behaviour of polymer/metal composites. In polymer/metal composite visco-elastic nature of the matrix is a barrier for the evaluation of elastic moduli of the composite. The evaluation of elastic moduli by ultrasonic technique stands out as promising basis for the characterization of composites. Ultrasonic characterization of particulate filled composites is gaining importance in recent years.

Present work has been undertaken to develop conducting composite material using commercial grade metal-powder having varying particle size, mixture of different metal powders and metal coated glass fibre as filler in various polymer matrices. These fillers are nonspherical having irregular surface. Their electrical resistivity and ultrasonic parameters and other morphological studies and features have been studied. Thus various polymer/metal composites of PE/Cu, PVC/Cu, PVC/Al, PS/Al, PVC/Cu-Al, PVC/Aluminium coated GF and PS/Aluminium coated GF are prepared. PE/Cu composites are prepared by melt compounding and hot pressing technique. Rest of the composites

are prepared by mechanical mixing and hot pressing technique. Commercial grade MoS_2 filled nylon 66 is also included for ultrasonic characterization.

D.C. Electrical resistivity of polymer/metal composites has been measured at room temperature. Their ultrasonic parameters such as absorption and dispersion at various frequencies have been measured. The state of filler distribution in the matrix of the composite is studied by optical microphotography and scanning electron micrography. The thermal analysis of these composites (DTA) and X-ray diffraction study are also undertaken.

It is observed that there is matrix-filler interaction in these composites which is reflected in segregated network formation, DTA, and X-ray diffraction study. D.C. electrical measurement has shown that in the case of PE/Cu composite limiting resistivity (3.98×10^6 ohm-cm) is maximum at the highest metal powder loading (23.2 v% copper). The resistivity of PVC/Al coated GF is the lowest at minimum (10 ohm-cm) loading of the metallic filler (20 w% Al coated GF).

The limiting resistivity of PVC/Al CGF is lower than PS/Al CGF. The limiting resistivity of PVC/Cu-Al composite is lower than PVC/Cu and PVC/Al composite. Resistivity of PVC/Al is lower than PS/Al composite.

On comparing the experimental results with the existing

theories it is observed that Bhattacharya's model gives qualitative agreement with experimental results. This model considers the segregated network formation of fillers of spherical and non-spherical nature. No adequate theory is existing to quantify, threshold of percolation in polymer-Al coated glass fibre composites.

The ultrasonic absorption, velocity studies show the presence of a cut-off frequency indicative of presence of filler resonances. Absorption is also due to single and multiple scattering of ultrasound by the fillers. Total absorption and velocity changes are expected to be due to a complex process involving single, multiple scattering and resonance effects.

The relative modulus evaluation from ultrasonic velocity and density of the composite is highest in PVC/Cu-Al composites followed by aluminium coated GF composites and then PVC/Cu composites at 9 MHz. The lowest modulus is in aluminium filled composites. This shows that the combined effect of reinforcement of copper-aluminium particles is greater than that of aluminium coated GF. In all cases qualitative agreement has been obtained with Mooney equation giving the variation of relative moduli with composition.

It is found from the variation of ultrasonic absorption and relative velocity with composition that though there is a drastic change in absorption at low concentration and change in

v/v_0 (normalised velocity) near the concentration of network formation but these changes may be more due to the effect of resonance of fillers and change from single to multiple scattering of ultrasonic waves. Hence there seems to be no direct correlation between the changes in relative velocity and absorption with the network formation.