Analysis of Mesamoll-Levamelt mixture for Particle Image Velocimetry

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ABSTRACT: Particle Image Velocimetry is a technique used for flow visualization in two-dimension. The experiment carried out was to determine the optimum matrix fluid concentrations for carrying out the PIV analysis.

KEYWORDS: Flow visualization, tracer particles, laser, optical images, refractive index

1 INTRODUCTION

Particle Image Velocimetry (PIV) is a flow visualization technique. The fluid is seeded with small tracer particles which are assumed to faithfully follow the flow. The fluid with entrained particles is illuminated and the motion of the tracers is observed to determine the velocity profile of the fluid. PIV is primarily used for two-dimensional flow visualization, though it can be utilized to produce three-dimensional vector fields as well. [1],[2]

Typical PIV apparatus consists of a camera, a strobe or laser with an optical arrangement to limit the physical region illuminated, the seeding particles and the fluid under investigation. A fiber optic cable or liquid light guide may connect the laser to the lens setup. PIV software is used to post-process the optical images. (Figure 1.1).

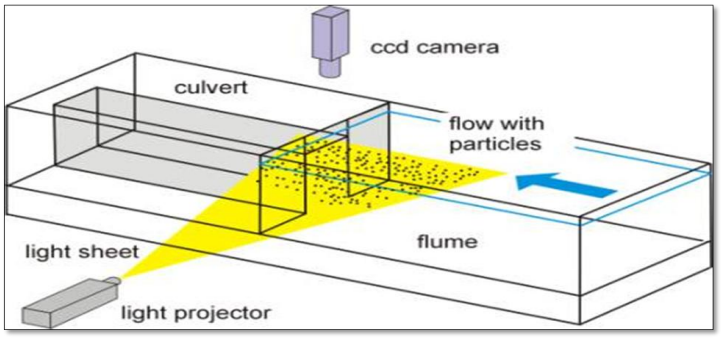

Figure 1.1 Basic Representation of two-dimensional PIV analysis [3]

The accuracy of the images, obtained from the PIV setup, in representing the actual flow field is highly dependent on the difference in the refractive indices of the fluid and the seeder particles. Thus, it is desirable to have the matrix fluid as transparent as possible.

For the purpose of PIV analysis in suspensions simulated by Mesamoll-Levamelt-PMMA mixtures, the criteria for optimum transparency need to be ascertained.

2 MATERIALS AND METHODS

The suspension analyzed was a mixture of Mesamoll, Levamelt and Poly (methyl methacrylate). The PMMA concentration was kept fixed at 25% of the total volume. The volume ratio of Mesamoll to Levamelt was varied from 55:45 to 75:25. For preparing the mixtures, a Rheomix Kneader was used.

For each concentration, three samples were extracted and the transparency values were recorded at temperatures varying from 50^{o}C to 80^{o}C, using a lux meter. The results are recorded in table 2.1

TRANSPARENCY PERCENTAGE							
COMPOSITION	TEMPERATURE (°C)						
(%)	50	55	60	65	70	75	80
55	3.463149	3.446541	3.446826	3.443456	3.405245	3.367131	3.34604
57	3.237018	3.224319	3.21984	3.227446	3.176819	3.138995	3.108852
59	2.51675	2.515723	2.526272	2.541296	2.51269	2.488382	2.460822
61	2.696817	2.679245	2.669189	2.642948	2.571912	2.463033	2.422702
63	2.784757	2.754717	2.71963	2.681067	2.601523	2.530629	2.49047
65	3.525963	3.454927	3.32913	3.193562	3.024535	2.881284	2.655654
67	3.237018	3.215933	3.165195	3.096146	2.973773	2.792564	2.549767
69	4.061977	4.008386	3.930223	3.782296	3.57022	3.248838	2.858958
71	4.015913	3.97065	3.896595	3.786531	3.58714	3.286861	2.833545
73	5.875209	5.794549	5.641026	5.455316	5.152284	4.740177	3.955951
75	5.40201	5.362683	5.262715	5.133418	4.898477	4.541614	3.867006

Table 2.1

The trend observed in the relative transparency values can be analyzed graphically from Figure 2.1 and Figure 2.2

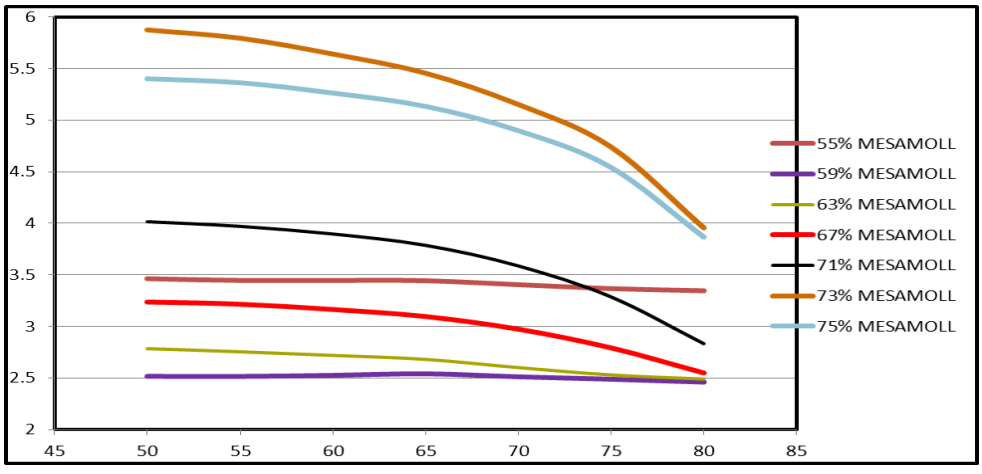

Figure 2.1

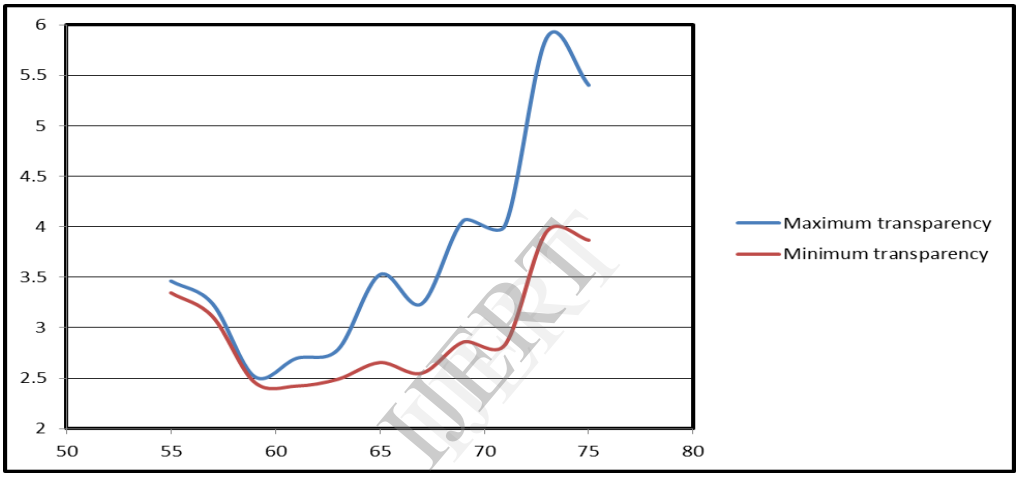

Figure 2.2

3 CONCLUSION

The transparency values are found to strictly decrease with increase in temperature, keeping the concentration constant. For a fixed temperature, the transparency value is observed to experience a peak in the range of 73-75% relative Mesamoll concentration.

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