QUALITATIVE ESTIMATION OF PERSPEX DUST SIZES BY SIMPLE DISSOLTION IN CHLOROFORM

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ABSTRACT**:** *Plastics and its composites have been used in almost every field. Fabrication of plastic composites usually involves making of its solutions.Usually, the uniform dissolution of plastic is a desired condition which may be affected by varying sizes of plastic grains and by the use of volatile solvents. In this paper qualitative estimation of plastic dust sizes were performed by its dissolution in chloroform using the simple method of weighing the solution at different time intervals. Perspex(PMMA) dust was obtained by drilling Perspex (PMMA, poly mehyl meta acrylate) sheet. To avoid thermal degradation of the plastic the drilling intervals were kept small (05 to 10 sec) . The plastic dust obtained were categorized according to their sizes as, 'Mixed' (≤ 1mm to approx1.5cm) and 'Fine' (1mm to 1.5mm approx). Three samples, 1200 mg 'Mixed', 1200 mg 'Fine' and 400 mg 'Mixed' were immersed in 10.9 ml,10. 6 ml and 11.3 ml of chloroform respectively in identical beakers. When the sample 400 mg (Mixed) dissolved, another 800mg (Mixed) with 1 ml chloroform were added to its solution. To determine the solvent evaporation rates the solutions were weighted every 05 minutes. The reactant masses verses time graph has shown distinct regions of small slopes which was due to lowering of evaporation rate of chloroform. These regions were identified as due to floating of swelled plastic dust of approximately same sizes which reduces the surface area for evaporation of chloroform. This lowering of evaporation rate of chloroform was thus used for qualitative estimation of different size groups of the plastic dust. With proper calibration, the method may prove to be a suitable, an inexpensive and quick estimation of plastic grain sizes. The idea may also applicable to similar situations*.

Keywords: PMMA dissolution, Evaporationrate, Plastic grain sizes

INTRODUCTION

Plastics are playing a very important role in industries and in the field of scientific research due to its chemical and physical properties. The properties of plastic or its blends are usually studied in their solution form or by studying their films [1,2]. Fabrication of polymer nano spheres, nano fibers, and composites of polymer with diferent materials, when perormed using polymer solutions, require its homgenous dissolution [3,4].Chloroform was found to be a good solvent for some plastics, but since it is a volatile solvent its proportion in the solution varied due to its evaporation, and hence affects the end product. Some plastics such as PMMA and its blends were studied with different proportions of solvent and solutes and their varying solubilities were reported [5,6].

The general mechanisim of plastic dissolution starts with its swelling. At a critical point of its swelling the polymer chains start dissolving in the solvent [7] .

The dissolution of plastic grains in volatile solvents suffered with constant reduction of the solvent amount due to its evaporation .Further, if the plastic grains are of different sizes their dissolving time varies which may affect the properties of the end product. Hence a quick qualitative estimation of the plastic grain sizes may help in deciding the most suitable, reactant quantities, and parameters for its uniform dissolution in volatile solvents.

In this paper Perspex (PMMA) was studied for its dissolving properties in chloroform, in the form of its dust and by observing reactants weights, estimation of solvent's rates of evaporation was performed. The study of the evaporation rates from the curves gives qualitative information about the groups of plastic particles of approximately same sizes with an idea of their dissolving times.

The aim of this work was to get a qualitative idea of the plastic dust sizes in the sample and to estimate the relative dissolving times of these groups of plastic dust.

MATERIALS AND METHODS:

Perspex (PMMA, poly methyl meta acraylate) dust, (Fig#1) was produced by drilling Perspex sheet for a small interval of time (5 to 10 sec) to avoid thermal degradation of the plastic due to heat generation. Two categories of Perspex particles named ‘Mixed’ (01mm to 1.5mm) and ‘Fine’ (01mm to 1.5mm) were made.

Three samples,1200 mg ‘mixed’(B, black curve),1200 mg ‘Fine’ (C, purple curve) and 400 mg 'mixed' (A, red curve) were immersed in 10.9 ml,10. 6ml and 11.3 ml of chloroform respectively in identical beakers .When the 400 mg (mixed) dissolved, 800 mg ‘mixed’ with 1.0 ml chloroform were added to the solution.The quantities of solvent were calculated using the observed density of chloroform.

The reactants masses were noted with a five minutes interval, and the solution masses versus time was observed every 5 minutes, Fig # 2. The solutions were manually shaken when the solution surface was observed to be filled with swelled plastic gel.

RESULTS & DISCUSSIONS:

Change in evaporation rates was observed as a function of time (Fig # 2, 3).

This change in evaporation rates was found to be due to change in the surface area of the solvent, available for the evaporation. The open surface area of the solvent was changed due to floating of the swelled plastic particles which rose to the surface of the solvent. This swelled particle layer was of the finest plastic dust that react quickly with chloroform.

The length of these curves could also gives relative concentration of the different grain sizes in a sample.Qualitative estimation about the size groups of plastic particle in a sample could be made until the surface of the solvent turns to thin solid membrane and the rest of the solution as a very thick semi liquid, fig # 4. The limit of estimating plastic particle sizes using this simple method could be increasesd by using less volatile solvents.

Fig # 1: PMMA sheet drilled threads

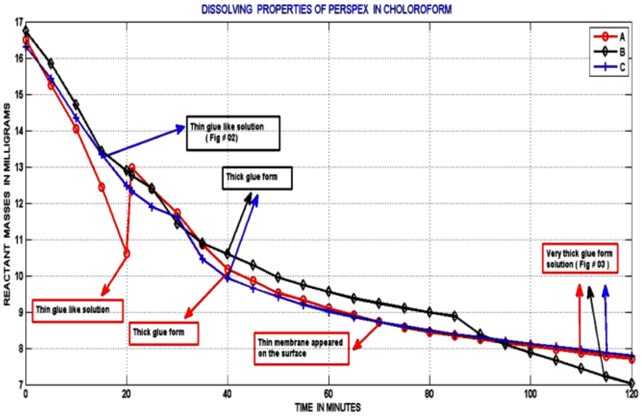
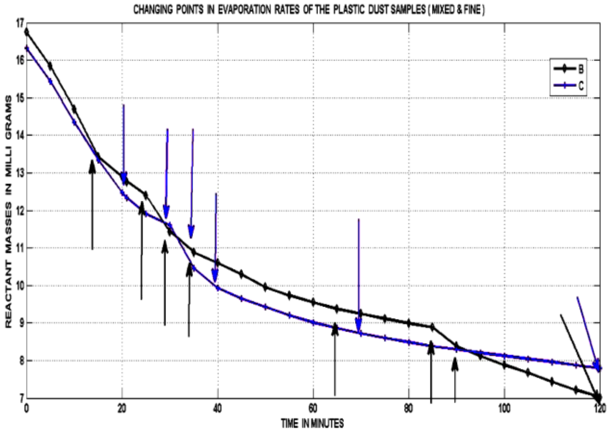


Fig # 2 : Sample solution weights verses time of reaction.(A): 1200 mg of sample 'Fine', (B):1200 mg of sample 'Mixed' ,(C):



1200 mg of sample '.Fine'.

Fig # 3 : Sample solution weights verses time of reaction .(B):1200 mg of sample 'Mixed' ,(C): 1200 mg of sample 'Fine'.

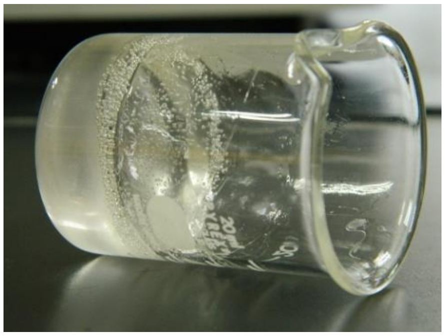


Fig # 4: PMMA viscous solution at 120 minute of reaction

When this layer of finest plastic particle dissolves, the solvent regain larger surface area for its evaporation, and hence evaporation rate increases . Another layer of swelled plastic particles of comparatively larger sizes rose to the surface, and again the evaporation rate of the solvent reduces. In this way particles of larger sizes, in groups, forms layers on the solvent surface, thus giving successive intervals of increasing and decreasing evaporation rates of the solvent. The interval between two successive high evaporation regions in the evaporation graph indicates a group of particles of approximately same sizes.

The solution of the sample, 'Mixed' has shown three regions by lowering its evaporation rates, which was approximately in the recession period of 16 to 25 minutes, 30 to 85 minutes and 90 to 120 minutes. On the other hand the solution of sample 'Fine' has shown two groups of particles, identified by lowering in its evaporation rate during the reaction periods of 20 to 30 minutes and 35 to 120 minutes, fig # 2,3.

It was observed that the first lowering in the evaporation rate of the solution 'mixed' was little earlier than the solution of sample 'fine'. It was concluded that as the sample 'Mixed' contain a group of grain having bit smaller sizes than the smallest grains of sample 'fine'. As the range of grain sizes of the sample 'fine' was not very large , we can expect only two two groups of grain sizes indicated by two regions of lower evaporaion rates. In the same way, as the range of grain sizes in the sample 'Mixed' is high , we can expect more than two groups of similar sizes.The similar pattern for sample ,'mixed' and ' fine',after the first dip corresponds with the same grain sizes which may be between 1mm to 1.5mm.

Comparing the graphs of mixed and fine samples, this simple method could discriminate grain sizes less than 1mm, 1.5mm and above1.5mm. The split dissolution of sample' fine', appeared the same as its 1200 mg dissolution.

CONCLUSIONS

A qualitative information about the different sized particle groups in a sample could be established by monitoring the reactant’s weight variations with time.

This simple technqie was found discriminate sucessfully plastic particle sizes, less than 1mm, 1.5mm and above 1.5mm.With the use of less volatile solvents, the choice of the most suitable evaporating area and some caliberation, the method is expected to be useful to discriminate effectively plastic grain sizes.

REFERENCES :

[1]. Vorlesung, 'Polymer thin films' / Lecture: Hans-Ulrich Krebs.

[2]. Ennis, D., Betz, H. & Ade, H. (2006). Direct spincasting of polystyrene thin films onto poly (methyl ethacrylate). Journal of Polymer Science Part B: Polymer Physics, 44(22), 3234-3244,(2006).

[3]. Lok, K. P. & Ober, C. K. Particle size control in dispersion polymerization of polystyrene. Canadian Journal of chemistry, 63(1), 209-216, (1985).

[4]. Anastasia M. Baker, Dr. Jon Kellar, 'Fluorescence of silver nano particles in polymer solutions for direct write technologies' (2010).

[5]. D. Cossement a,, R. Gouttebaron a, V. Cornet b, P. iville b, M. Hecq a, R. Laz zaroni b. 'PLA-PMMA blends, A study by XPS and To F-SIMS' (2006).

[6]. Chan Kok Sheng M.I.N. Isa, L.H. Loo. "Study of Formation and Characterization of Cds/Pmma Composite Film" (2012).

[7]. Miller-Chou, B. A. & Koenig, J. L. (A review of polymer dissolution. Progress in Polymer Science, 28(8), 1223-1270, 2003).