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Studies on grafting in a polymer by thermal analysis

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Abstract

Guargum-*graft*-acrylamide (G-g-Am) is a modified natural polymer and has considerable biodegradation resistance and is an efficient flocculent for metallic ions. G-g-Am can be prepared by ceric ion initiation method. Evidence of grafting may be obtained rheologically by study of apparent viscosities. But thermal analysis may be an alternate method to understand possibility of grafting. In this investigation, DSC plots for G-g-Am and polyacrylamide are compared and DTA plot for industrial polyacrylamide is studied to understand difference in product formed near about 223 °C which indicates possibility of presence of graft in G-g-Am obtained by ceric ion initiation method.

Keywords: Guargum, graftcopolymer, differential thermal analysis, differential scanning calorimetry, ceric ion initiation

1. Introduction

Guargum is a water soluble natural polymer and has good industrial use ^[1]. Its structure is relatively known (fig.1). But Guargum has poor biodegradation resistance ^[2]. If polyacrylamide side chains are grafted on guargum, resulting graft copolymer becomes considerable biodegradation resistant and efficient flocculent for metallic ions ^[3]. Guargum – *graft*- acrylamide (G-g-Am) can be obtained by ceric ion initiation method ^[2]. Characterization of G-g-Am has been made by ESCA study and thermal analysis ^[4]. Further evidence of grafting in case of G-g-Am may be obtained by DSC analysis using G-g-Am and polyacrylamide samples and DTA study for polyacrylamide. DSC plots for G-g-Am and for polyacrylamide are different. This is an important point in this investigation.

2. Materials and Methods

2.1 G-g-Am: Guargum –*graft* – acrylamide (G-g-Am) was obtained from Rheological Laboratory of I.I.T., Kharagpur, India. From ESCA study, it was possible to understand that it contains about 11 atom% nitrogen, 22 atom% oxygen and 68 atom% carbon ^[4,5]

2.2 Polyacrylamide: Polyacrylamide for DSC study was obtained from Rheological Laboratory of I.I.T., Kharagpur, India and Industrial polyacrylamide for DTA study was obtained from I.T.C. Limited, Tribeni Tissue unit, Hooghly, West Bengal, India. Molecular weight of the polymer is high and Brand name of the material is Maxfloc C11. It was supplied from Thermax Company.

2.3 DSC: Simultaneous DSC and TGA analysis have been carried out using STANTON Redcroft Sta 625 simultaneous thermal analyzer in static air.

2.5 DTA: For simultaneous DTA and TG analysis, Pyris Diamond TG / DTA instrument has been used. Name of the company is Perkin Elmer. Simultaneous DTA and TGA have been carried out in presence of air up to 600 °C. Heating rate 10 °C/min. Sample used 10.24 milligrams (approximately).

3. Results and Discussion

DSC plots for G-g-Am and polyacrylamide are shown in fig.2 and fig.3 respectively. DTA plot for industrial polyacrylamide is shown in fig. 4. In case of G-g-Am, near about at 223 °C, in DSC plot (fig. 2), there is an endotherm.

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This indicates cyclic imide formation or acid anhydride formation near about at 223 °C [3, 6]. In case of industrial polyacrylamide, near about at 270 °C, there is an endotherm like in DTA plot (fig. 4) but it is absent in DSC plot for polyacrylamide (fig. 3) [7]. This indicates, cyclic imide formation or acid anhydride formation [7] in case for polyacrylamide gives different product probably of higher specific heat ($H = m.s.t.$) than that in case for G-g-Am. This indicates G-g-Am is a graft copolymer obtained from ceric ion initiation method. This is also in accordance with earlier report [4] based on TGA.

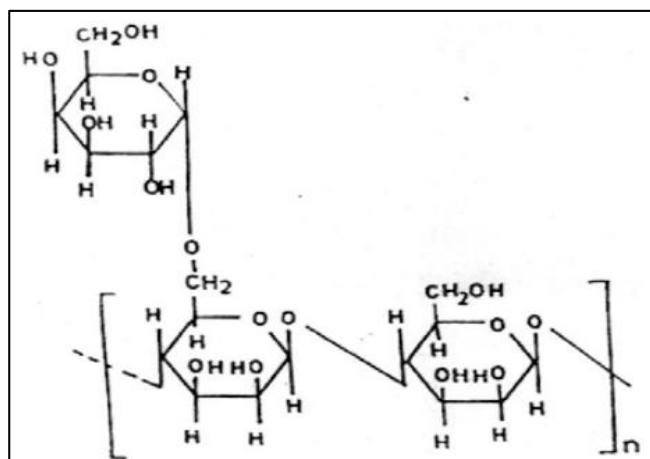


Fig 1: Structure of guar gum

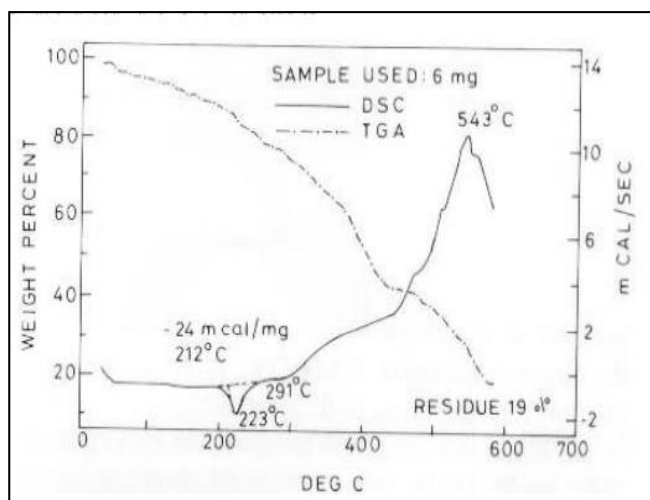


Fig 2: DSC and TGA thermograms for G-g-Am

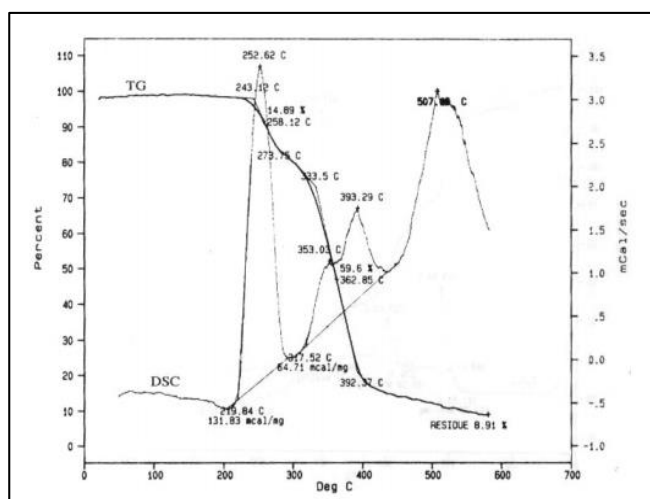


Fig 3: DSC and TGA thermograms for polyacrylamide

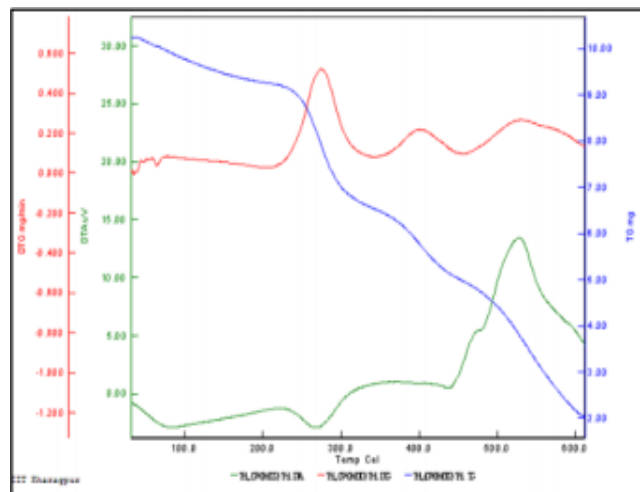


Fig 4: DTA, TGA and DTG plots for industrial polyacrylamide sample. (DTA plot at the bottom).

4. Conclusion

Aqueous solution of guar gum-*graft*-acrylamide (G-g-Am) is a good flocculent for metallic ions like Y^{3+} , Ba^{2+} and Cu^{2+} at different pH ranges [3, 6]. So this polymer has importance. G-g-Am can be obtained from guar gum by ceric ion initiation method. This present work indicates thermal analysis has importance in understanding whether grafting has taken place or not. This is an easy and new approach for characterization for G-g-Am.

5. Acknowledgement

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6. References

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