2018 PVC Plastication
2/23/2018

6

THE UNIVERSITY OF TEXAS AT AUSTIN
DEPARTMENT OF CHEMICAL ENGINEERING
CHE 395E

THE PLASTICIZATION OF PVC

I.Object

Polyvinylchloride, PVC, is a glassy polymer at room temperature with a softening temperature near 80 ^{o}C. PVC can be modified to be flexible and rubbery at room temperature by adding high molecular weight oils, called plasticizers, which reduce its glass transition temperature or softening temperature. The object of this experiment is to determine the minimum amount of di-octylphthalate plasticizer (DOP) required to achieve flexibility at -40 ^{o}F

II. References

1. Billmeyer, F. W., "Textbook of Polymer Science, 2nd Ed.", (1971).

2. Various editions of Modern Plastics Encyclopedia, including 51(10a), 1974-75, p. 244; ..§(10 a), 1969-70..

3. E. H. Andrews, "Fracture Processes in Polymers", American Elsevier, New York, 1968.

4. M. B. Neiman, "Aging and Stabilization of Polymers", Consultants Bureau, New York, 1965, Chapt. 6.

5. Vincent, P., Polymer, 1, 425 (1960)

6. E. Baer, "Engineering Design for Plastics", Polymer Sci. and Eng. Series, Reinhold, New York, 1964, p.112.

III. Equipment and Supplies

1. Two-roll mill, Brabender or equiv., 3" x 6" rolls, oil heated.
2. Brass scraper tool and doctor blade for roll-mill.
3. PVC Resin, general purpose.
4. Di-octylphthalate plasticizer, or equivalent.
5. Hadvastab PVC stabilizer, or equivalent.
6. Differential Scanning Calorimeter, Perkin-Elmer DSC4 or equivalent.
7. five 250 ml beakers.
8. Stirring rod.
9. AC wax

IV. Procedure

l. Vinyl compounds are typically specified using 100 parts of resin as the basis. All additives are specified per hundred parts of resin, phr. Use the following master mix for all compositions: 100 PVC with 0.5 phr PVC Stabilizer

2. Prepare dry blends of the master mix with 20, 40, 60, and 80 phr of plasticizer. These are prepared by mixing the oil and powder together in the beaker. Mix thoroughly and allow to stand for 20 min. prior to processing on the mill.

3. Preheat the two-roll mill rolls to 160-170 ^{o}C (see attached calibration curve).

4. CONSULT INSTRUCTOR BEFORE ATTEMPTING TO OPERATE THE MILL.

5. Place the catch pan below the rolls. Start the mill and pour the polymer/plasticizer mixture into the roll nip (the nip is the space between the rolls). Some material will fall through the nip to the pan below. This material should be transferred back to the nip. Continue until the material has melted or "fluxed" and has formed a continuous bank, or standing wave, in the roll nip. Adjust the nip spacing, if necessary, to achieve the wave. Engage the doctor blade and scrape the molten material from the rolls to the tray below. Transfer the material back to the nip for further mixing. Repeat the scraping and transfer operation at least one more time.

6. Remove the material from the mill and place it on the metal table to cool. If done carefully, a sheet of molten material may be stripped off which will be useful for qualitatively judging relative flexibility of the various compositions.

7. Repeat steps 5 and 6 for all compositions.

8. Prepare a 20 phr plasticized compound which contains 2 phr AC Wax. Note any differences in processability between this composition and the one without the AC wax material.

9. Prepare a compound which contains 20 phr plasticizer but no stabilizer. Note what happens when this is processed. Do not leave it on the mill too long! 10. Your instructor will help you obtain the glass transition temperatures of your compounds with the Perkin-Elmer DSC in Room CPE 3.464.

V. Report

1. From your experimental observations, what is the purpose of the AC wax? of the plasticizer? of the stabilizer?

2. Briefly discuss the chemistry of PVC degradation and stabilization.

3. How is the polymer flexibility related to its glass transition temperature? From your data, what level of plasticizer is necessary to achieve some flexibility at -40 ^{o}F? Would you need to add more or less plasticizer to obtain a shower curtain type of flexibility at this temperature? Does the incorporation of plasticizer also affect processability of the melt? In what way? Do rigid PVC extrusions contain plasticizer?