JOURNAL OF APPLIED POLYMER SCIENCE VOL. 11, PP. 921–924 (1967)

Simple Microtome for Sectioning Cellular Foam

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Synopsis

A simple, inexpensive microtome was developed for sectioning polystyrene foam prepuff. The cell structure is well defined and wall thicknesses can be measured easily from photomicrographs prepared with the microtome.

For many years microscopists have been accustomed to embedding cellular materials in order to make them rigid enough for satisfactory sectioning. The insolubility of most animal and vegetable cellular materials in synthetic embedding materials has made this possible. Some synthetic cellular polymers can also be embedded or sectioned directly with a standard microtome.

In studying cell size and distribution of polystyrene foam "prepuff" we found it necessary to section individual beads of the prepuff. The prepuff is formed by subjecting polystyrene beads filled with a gas such as pentane to heat.[1] Sectioning of the prepuff presents a particular problem in that the cell structure is fragile and most embedding materials partially dissolve the polymer.

Giuffria developed a method for examining expanded foam based on adding a poly(vinyl alcohol) solution to the foam, allowing it to dry, and then cutting a section.[2] The poly(vinyl alcohol) is next washed out, and the specimen dried and mounted. This procedure is lengthy and has the disadvantage of subjecting the polymer to a treatment before any examination has been made. Our objective was to develop a rapid method for sectioning specimens without any prior treatment.

The main difficulty in sectioning with a standard microtome is in holding the prepuffs, which usually have a diameter of 0.003–0.125 in. The problems of holding the sample firmly and slicing a uniform section soon became evident in photomicrographs having a field of varying focus. This problem prompted the authors to design a simple microtome to help insure uniform measurable sections.

Equipment

The final design of the microtome is shown in Figure 1. The microtome has a base plate with an Allen type set screw and two Allen cap screws for attaching a die. The bottom of the base plate was radially scribed in

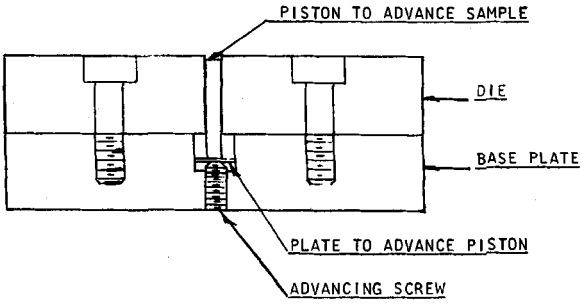

Fig. 1. Cross-section of microtome showing details of construction.

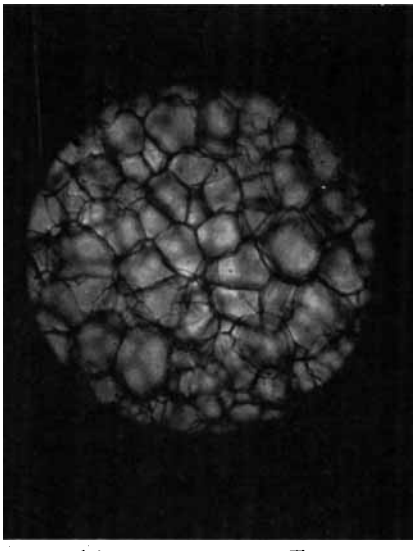

Fig. 2. Center of foam puff, 200×. Focus on cut surface.

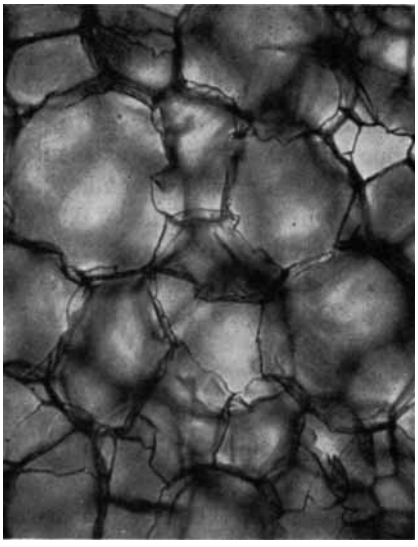

Fig. 3. Center of foam puff, 400×. Focus on cut surface.

$^1/_{16}$ increments to aid in obtaining the proper section thickness. A piston, machined to a sliding fit, is set in the die and can be raised to any desired height by turning the set screw. Several dies, each with different size die apertures and pistons for each, were made for sectioning various size prepuff beads. Both the base plate and dies were made from a 316 stainless steel with ground finish throughout.

Operation

The operation of the microtome is as follows. A die that is slightly smaller than the foam prepuff to be sectioned is mounted on the base plate. The advancing screw is turned back enough to insert the piston and to leave room for the prepuff. The prepuff is pressed into the die by using a soft material such as an eraser. The screw is advanced just enough to push the prepuff top slightly above the surface of the die and the top re-

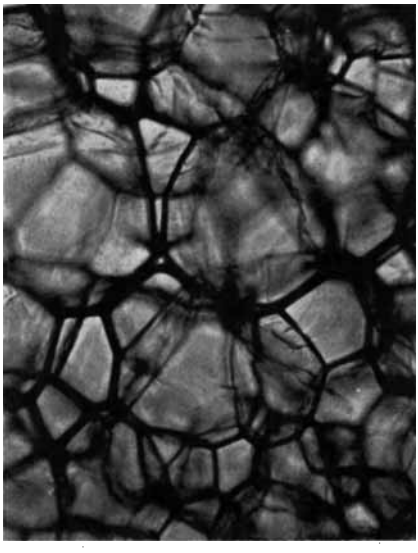

Fig. 4. Center of foam puff, 400×. Focus on puff interior.

moved by sliding a sharp razor blade across the surface. Specimens of the desired thickness can then be prepared by advancing the screw the proper amount. It was found that sections of about 0.001–0.003 in. were best for observing the cell structure. This represented about $^1/_{16}$ of a full turn of the advancing screw.

Photomicrographs of a polystyrene prepuff sectioned with a microtome are shown in Figures 2–5. The magnification is from 200× to 1000×. The honeycomb structure and cell walls are well defined in these photomicrographs.

Fig. 5. Single foam cell, 1000×. Focus on cut surface.

References

1. G. C. Kiessling, in *Handbook of Foamed Plastics*, R. J. Bender, Ed., Lake Publishing Corp., Libertyville, Ill., 1965, Section XIII, p. 255.
2. R. Giuffria, *Mod. Plastics*, **36**, 150 (June 1959).

Résumé

Un microtome simple et peu couteux a été mis au point pour découper des mousses de polystyrène. La structure cellulaire est bien définie et l'épaisseur des parois peut être mesurée facilement au départ des micrographies préparées avec le microtome.

Zusammenfassung

Ein einfaches wohlfeiles Mikrotom zur Herstellung von Schnitten aus Polystyrolschaum wurde entwickelt. An Mikrophotographien von Mikrotomschnitten kann die Zellstruktur festgelegt und die Wanddicke leicht gemessen werden.

Received September 2, 1966
Prod. No. 1504