

High Temperature Resistant Polymers, A. H. Frazer, Interscience, New York, 1968. xiv + 338 pp. \$17.50.

During the past decade we probably have witnessed the publication of more reports on synthetic polycondensation reactions than has occurred since the early days following Carothers' original work. The reason for this activity was the discovery of the thermal stability of wholly aromatic polymers. Actually, this stability was known to exist but no practical routes were known for preparing high molecular weight *tractable* polymers which could be studied. The two key elements in advancing this field—(1) the use of heterocyclic groups in the polymer backbone to enhance solubility and (2) the preparation of aromatic polymer in solution via low temperature polycondensation techniques—were due to the work of C. S. Marvel and P. W. Morgan, respectively.

It is indeed fortunate that a work covering the field of thermally stable polymers has now been prepared by an author who has used the techniques of both (1) and (2) in his work and was one of the pioneers in using (2) for the preparation of soluble precursor polymers for insoluble heterocyclic polymers. Furthermore, Frazer brings to *High Temperature Resistant Polymers* an intimate knowledge of the evaluation procedures necessary for determining the thermal stability of polymers.

The presentation of the material of the book is well conceived and executed. The liberal use of tables and figures makes the work a valuable reference. Relatively few typographical errors or incorrect drawings appear, and, fortunately, when these occur they are obvious enough so that incorrect information should not be obtained by the reasonably careful reader.

For those who have worked in this area, it is well known that this is a most "sinned against" field, i.e., many papers have been published describing "thermally stable polymers" but the data given (and sometimes there is precious little of that) belie the contention. Also, there is the problem that retention of weight to a high temperature and/or possession of a high melting point, the most often used criteria of stability, are only the beginnings of the determination of thermal stability (or temperature resistance, as Frazer prefers to say, with much justification). Therefore, it is particularly gratifying to this reviewer to see an entire chapter devoted to definitions of thermal stability, especially definitions which include tensile properties, time, and environment. Chapter I should be read and reread by prospective authors (and reviewers too) of papers concerning thermally stable polymers. In particular, the section beginning at the bottom of p. 22 on the determination of thermal stability should be learned and no polymer which does not fit the definition at the top of p. 23 should be called thermally stable.

Since the chief purpose of the tremendous efforts in this field has been to prepare adhesives, resins, films, and fibers which can be used at elevated temperatures, it is an important feature of this work that end use applications are discussed in some detail with supporting data. However, in presenting the synthetic work of others, it is unfortunate that Frazer all too often accepts the various authors' statements concerning the stability of their polymer at face value and does not place the work in perspective in terms of his own knowledge and experience, particularly in the applied field.

A work of the present type has been sorely needed, although numerous review articles and at least two books have treated the synthetic aspects. However, despite the issue date of 1968, it is obvious from a consideration of several internal evidences that the text was prepared some time ago, probably about 1965. Since most of the fruit in this area was borne more recently, particularly in the years 1966–1968, the timing, in a sense, is most unfortunate because this field seems to have peaked. While a review of the area is most welcome, a slightly more up-to-date work probably would have covered this field adequately for several years to come. As things stand, a real need exists to bring the field up to date even at this writing. The author obviously has tried hard to work in, by way of addition, most of the later contributions by using numerous references under a single number and employing subreferences, i.e., (a), (b), etc. While we thank the

author for these additional references, the text is left somewhat lacking in detail and actually some confusion arises as to what author did what. When the authors are from different institutions, the problem becomes acute, e.g., in Table XXI, p. 184, polymers 87 and 88 are assigned only ref. 76. But ref. 76 actually is 76(a), (b), and (c); only 76(a) pertains to the polymers of Table XXI. Furthermore, tabulations of results from several works often are given with the several references but not in such a way as to indicate the contributions of the various workers. It would have been a simple matter to have placed the references in a way which would have given the reader ready access to specific items from the original data.

A nagging flaw of the book for this reviewer was what appeared to be a tendency to overaccentuate the contributions of co-workers from the author's own company, even granted that these contributions are probably the most significant in the field. For example, for a property so fundamental and frequently cited as the polymer melt temperature (PMT), it seems that the author should have defined it once in the text (he didn't) and then should have used the abbreviation PMT throughout in the tables where polymer melting points are given. Instead, the footnote "PMT, polymer melt temperature, See R. G. Beaman and F. B Craver, *J. Polym. Sci.*, **21**, 223 (1956)" appears in no less than 36 tables!

Although the reviewer has cited a few minor points which he found as petty annoyances, the work is a *must* for the serious investigator in this field, particularly for anyone who might wish to begin a study in this area. It is hoped that when it comes time to up-date the work concerning thermally stable polymers, Dr. Frazer will again undertake the effort.

J. Preston

Chemstrand Research Center, Inc.
Durham, N. C.