

## 75 Years of Polyethylene: Past Successes and Future Challenges

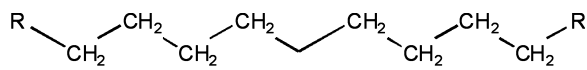
SCIENCE MUSEUM, LONDON, U.K.

MARCH 27, 2008

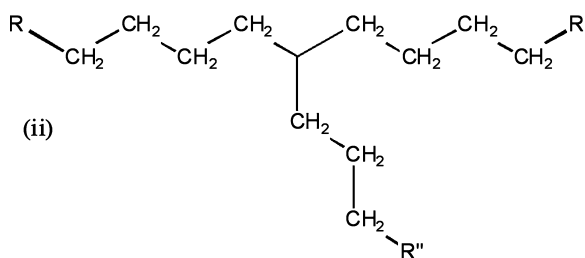
The 27th March 2008 was the 75th anniversary of the discovery of polythene. To celebrate this occasion, a group of scientists met at the Science Museum in London. The conference, organised by the authors on behalf of the Macro group of the RSC and SCI, the Polymer Physics Group, and the Science Museum, was entitled “75 Years of Polyethylene: Past Successes and Future Challenges” The aim of the meeting was at least in part to counter the somewhat negative image of polythene which had focused largely on the problems associated with disposal and degradation. This was summed up in an article earlier that week in the independent entitled “Polythene's story: The accidental birth of plastic bags” [1]. In this article Ron Sharp reflected that the anniversary was one no one would be celebrating.

On the basis of this meeting Ron Sharp was a little wide of the mark. The first session was devoted to not only to the discovery and development of polythene but also the future. In the chair was David Oxley who had his own memories of the polythene story, however a fuller overview was provided by Harold Fielding, formally of ICI; he reflected on the way polythene was discovered, the timeliness of the discovery (in particular in view of the vital role of this material as an insulator for cables used in Radar), and the way in which the processes developed. This theme was further developed by John Sale, who had spent many years involved in the marketing of polythene, and reflected on the way the market for polyethylene had developed in the past, and how it might develop in the future, he dis-

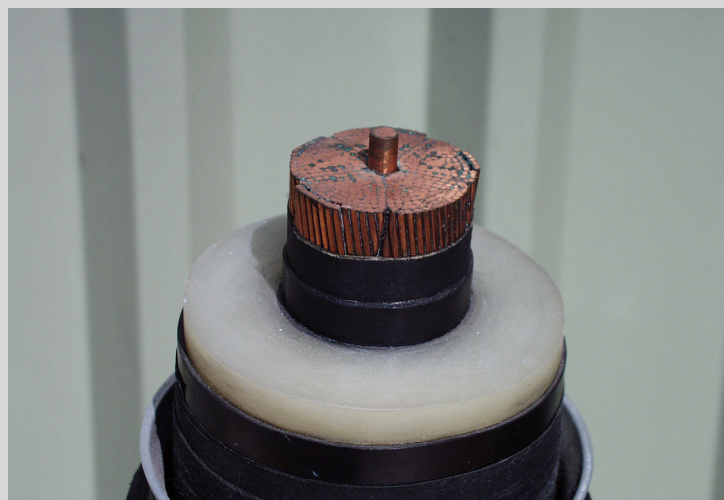
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(i)



(ii)



cussed the kaleidoscope of uses for polythene, ranging from cement sacks (which have to be stitched apparently) to radiation shields. The talks were accompanied by some enthusiastic discussion, particularly by the old hands from ICI, who were able to share a wealth of experiences.

An excellent lunch, and poster session was then followed by a tour of the plastics exhibition at the science museum. The audience were shown the original apparatus as used by Fawcett and Gibson, together with a vast array of materials produced from polymers, from an array of early 20th century Bakelite (including a rare Bakelite Coffin) items through a vast array of everyday items to light emitting polymers, and ideas for transport of the future.

Following this entertaining and informative interlude, the after-lunch session was "polythene challenges" and was chaired by Professor Manfred Bochman of the University of East Anglia, who provide a brief introduction to the chemical advances made in the construction of polyethylene systems. This was then followed by Professor Walter Kaminsky, who provided an outstanding overview into developments in metallocene catalysts, an area he made possible himself through his early work, and by which a range of new polythene materials are possible. The audience were particularly interested in his use of tandem catalysts to produce comb-like polythene with long crystallisable side-chains. Dr Jamie Hobbs, of the University of Sheffield then gave an excellent overview of the way polythene crystallises, and showed (literally by virtue of his videos of crystallisation in progress) that the simplicity of the repeat unit in no way matched that of its behaviour.

The final session was devoted to applications; this was chaired by Colin Richards, who clearly had some considerable experience of not only the advantages but also the challenges involved in polythene applications. The complexity of the behaviour exhibited by polythene

was further stressed in the talk by Dr Peter Hine (the University of Leeds) he focussed on ways of controlling the physical properties of polythene, the particular importance of processing in the development of mechanical structure was highlighted, as was the concept of "single polymer" composites. For example Dr Hine explained not only how the mechanical strength of polythene could be enhanced by orientation, but also how such a process could lead to new applications; in this way polythene can compete with Kevlar for high strength applications, for example. It was quite instructive to compare this with the talk given by Professor Kaminsky; who had shown how one monomer could be converted to a host of different materials; Dr Hine in contrast showed how by application of processing technology one polymer could be converted into a host of materials with different properties; it would seem there is plenty of science left in this old material yet! The final talk of the day was perhaps appropriately given by an industrial scientist and in a way turned the audience back to the original applications of polythene as an insulating material. Dr Simon Sutton (Dow) discussed the problems associated with using polyethylene for power cables and in particular explained why the development of polyethylene insulation for high voltage power transmission cables had proved to be a less than straight-forward process. The meeting closed with a vote of thanks from Professor Vaughan

In conclusion this proved to be an outstandingly interesting day, which was only made possible by the support of an array of companies and individuals, these are as follows: the Science Museum, the Centre for Advanced Microscopy at the University of Reading, the Worshipful Company of Horners, British Polythene Industries, the Institute of Materials, Minerals and Mining, SCI, the Polymer Physics Group of the Institute of Physics, and the Macro Group of the Royal Society of Chemistry and the Society for Chemical

Figure 1 (left): One monomer, many polymers: linear polythene produced using the Ziegler-Natta process (i) and a long-chain branched comb-structured polythene (ii) produced by Professor Walter Kaminsky using the tandem action of two single-site catalysts [2].

Figure 2: Full Circle: Originally designed for its potential as an insulating material, the many difficulties involved in the design of polyethylene insulated high-power transmission cables presented a major challenge; however cables such as the one shown here are now replacing the older oil and paper versions, and may have a number of environmental advantages.

## Conference Report II

Industries. Finally, whilst a scientific meeting of this type can do little to counter the current bad press of polymers in general and polythene in particular, by holding the meeting it was possible at least to put forward some of the many positive aspects of polymers often ignored by the press (and governments) to a more general audience. In particular Professor Mitchell and Professor Dame Julia Higgins spoke about polythene, the anniversary and the many uses other than packaging on "The Material World" (BBC Radio 4) [3]. In addition, by holding this meeting it was possible to counter the argument in the Independent and say "yes people are celebrating the discovery of polythene" A letter to this effect from the organisers was published in the independent on 31st March 2008 [4]. What was particularly apparent from this meeting was that polythene is not a single material either from a chemical or from a mechanical point of view and the material can be tailored for use in a wide range of applications.

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[1] <http://www.independent.co.uk/news/science/polythenes-story-the-accidental-birth-of-plastic-bags-800602.html>

[2] Sperber O, Kaminsky W: *Macromolecules* 36 (2003) 9014-9019

[3] [http://www.bbc.co.uk/radio4/science/the-materialworld\\_20080320.shtml](http://www.bbc.co.uk/radio4/science/the-materialworld_20080320.shtml)

[4] <http://www.independent.co.uk/opinion/letters/letters-dna-database-problems-803016.html>

## Conference Report III

### User Seminar of 2D and 3D Rheology of Fluids and Liquid Interfaces

MAY 6–8, 2008

POTSDAM, GERMANY

The second event of a new series of user seminars, dedicated to the rheology of structured bulk phases and two-dimensional interfacial layers, was organised by Anton Paar Germany GmbH (Ostfildern, [www.anton-paar.com](http://www.anton-paar.com)) and SINTERFACE Technologies (Berlin, [www.sinterface.com](http://www.sinterface.com)). After the first seminar was held 2007 in Berlin-Adlershof [1], the meeting venue was chosen this time in the conference hotel "Am Templiner See" in Potsdam [2], specialised in hosting meetings of different size, from small workshops to big conferences. The hotel provides lecture halls and all technical equipment as well as housing and all kind of services for a successful organisation of such type of workshops.

The second user seminar started with a half day training on the basics of 2D and 3D rheology, presented by experts of Anton Paar and SINTERFACE. This included an introduction into interfacial science of liquid interfaces in general and of mechanical properties of interfacial layers under

shear or dilation/compression. The basic knowledge on bulk rheology consisted of lessons on measurements in rotation and oscillation mode using various types of rheometer. This training course was essentially organised for beginners, however, almost all participants participated in it.

During the second and third day of the seminar lectures were given by experts of the two organising companies A. Paar and SINTERFACE and guest lecturers of the TU Berlin, ETH Zurich, the MPI of Colloids and Interfaces in Potsdam, and from industrial research departments of Nestlé, BASF and Schwan-STABILO. The 45 participants (see photo of Fig. 1) came from academic and industrial research institutions in Austria, Germany and Switzerland, so that all lectures were given again in German.

The seminar provided an introduction into the professional application of measuring instruments in bulk rheology when using them in rotational (P. Heyer, Ostfildern) or oscillatory modes

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Volume 18 · Issue 5

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