Computerization and Networking of Materials Databases: Third Volume

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editors

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Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

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Foreword

This publication, *Computerization and Networking of Materials Databases: Third Volume*, contains papers presented at the symposium on the Computerization and Use of Materials Property Data, held in Cambridge, United Kingdom on 9–11 Sept., 1991. The symposium was sponsored by ASTM Committee D-49 on Computerization of Material Property Data and The National Physical Laboratory. Thomas I. Barry of the National Physical Laboratory in Teddington, Middlesex, United Kingdom and Keith W. Reynard of Wilkinson Consultancy Services in Surrey, United Kingdom, presided as symposium chairmen and are the editors of the resulting publication.

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Overview

The Useability of Materials Property Data

It is paradox that in order to increase freedom, freedom must also be limited. To enable people and goods to travel smoothly from place to place, it is necessary to put in place standards that limit the freedom to travel at will. Ideally these standards should be adopted worldwide so that goods, for example, can pass with minimal checks between countries.

The whole of industry and commerce is now heavily computerized, from management, design, purchasing, processing and production, to sales. Each of these broad categories may employ many software products, all of which need to be integrated so that data of all types can be processed and acted upon with great reliability. The cost of this integration forms a large fraction of expenditure on software development and utilization. For this reason the standardization of the exchange of data will not only reduce costs but also make it much easier to introduce more efficient software, enabling user companies to avoid becoming locked into obsolete systems and allowing database and software developers to design with a view to integration.

As pointed out by Swindells in this volume, materials information is a commercial resource comparable with the finance, plant and the workforce, and it needs management to be used efficiently. The nomenclature and data required to characterise materials and their properties are complex which makes the need for standards for the exchange and use of the data particularly pressing. It is with these points in mind that the Third International Symposium, which was held at Cambridge in the UK, was given the name "Computerization and Use of Materials Property Data", reflecting the shift in emphasis from producers to users. The papers by Newley, Sargent et al and Bamkin et al amplify these points for individual companies and discuss the factors that have influenced policy and system design in the management of materials information.

These authors and those of other papers in this volume are contributing to the STEP Model of Materials Information which is described here by Rumble. It is STEP that will embody the standards for data exchange necessary to facilitate the free flow of materials property data and enable individual software products to work smoothly together without major effort.

In principle, companies and groups of companies could develop and use their own internal transfer standards. But of course it is not only within companies that materials data need to be exchanged smoothly and reliably. Data need to be transferred from and to test houses, data compilers and evaluators, researchers, educators, purchasers and subcontractors. The data need to be traceable to their origin and they need to be accompanied by metadata and information on their quality that can identify fitness for purpose.

From the above it can be seen that anyone, including senior managers, with an interest in manufacture, processing, measurement or data processing on materials will find topics to guide and assist them in this book. Those present at the Symposium noted the continual recurrence of a number of themes relating to data classification and organisation, terminology and expert systems. Readers will be able to gain different perspectives because they will usually find more than one paper relevant to their interests. They will be able to use these and the discussion material to gain insights that might otherwise be difficult to obtain. In many cases there is no unique best way of achieving the solution to a problem, indeed any solution is bound to require some compromise. For example, in storing data on a set of materials, is it best to give them a code that implies information about materials, as described by Lawrence and Forman or to assign the material an accession number completely devoid of meaning? Is it possible to define a hierarchy of materials in which materials with more closely defined characteristics inherit the generic properties of their parents or is it preferable to avoid the problems caused for example by multiple inheritance and treat each material as a unique entity?

Expert systems and databases

A number of papers in this volume describe the development and use of expert or knowledge based systems. These have proved to be very successful if the field is reasonably limited. The system described and demonstrated by Lees on Adhesives was one such. However, more comprehensive systems that attempt to cover all the aspects of materials information required by the designers of products and processes are beyond the scope of current possibilities. The limitations and future of knowledge based systems are discussed perceptively by Vancoille et al who consider the possible use of multimedia and hypertext. One of the potential uses for expert systems discussed in a number of papers is the exploration of databases looking for correlations in the data. Such procedures could run automatically on conventional databases and be used to generate rules and quantitative relationships or to expose inconsistencies in the data. Clearly, to be useful, the data in the database must have sufficient breadth to allow valid rules to be generated for the defined applications.

The trend in materials databases is towards the inclusion of software that greatly adds to the value of the stored data. A conceptually simple but very useful example presented by Ashby and Cebon allows the user to select materials that meet quantitative combinations of criteria such as strength, coupled with low density and thermal conductivity. This system like others demonstrated made very effective use of graphics. Three hours after the demonstration session opened the stands were still busy. All but one of the demonstrations were stand-alone systems and almost all used relatively standard personal computers. It is not appropriate to give details here but the spread of interests represented by the 18 demonstrators is significant, including corrosion, aluminium alloys, copper alloys, rubber, plastics, adhesives, ceramics, materials selection, organic chemicals and materials, metallurgical thermochemistry and phase equilibria, powder metallurgy and systems for management of materials property data.

Standards activities

The international bodies CODATA, VAMAS and ISO, through its activity on STEP, are all contributing to aspects of standardisation of materials data and databases. However, the only body with a comprehensive approach to standards for materials property data is ASTM, in which the sub-committees of E49 cover materials designation, terminology, data recording, data exchange, data and database quality and some aspects of chemical data. ASTM is keen for international participation in its work and for other countries to set up parallel activities so that the standards can be taken up by ISO. The fact that the Third Symposium was held at Cambridge was intended both to recognize the existing level of participation in ASTM E49 and to encourage effort worldwide. The UK National Physical Laboratory was very pleased to cosponsor the meeting because its Materials Metrology Division has the aim of fostering a traceable infrastructure for materials measurement in the UK and sees all the activities of E49 as relevant to its aims.

Concluding Remarks

The Editors wish to record their pleasure in being asked by ASTM to organise the Symposium at Cambridge and would like to thank the authors of the papers and those participating in the discussion for their contributions to this important endeavour.

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