

Book Review

Coal and Modern Coal Processing: An Introduction. Edited by G.J. Pitt and G.R. Millward, Academic Press, London, 1979, 210 pp., £ 8.50.

It is difficult to discuss any of the processing techniques in the coal industry without finding some aspect which can profitably be studied by a thermal analysis technique. Such subjects are carbonisation, combustion, the gasification and liquefaction of coal, and all these are included in this book, which is attractively priced by today's standards. It is based on a series of lectures given by the authors of the various chapters in the Chemistry Department of the University College of Wales, Aberystwyth to commemorate Dr. Walter Idris Jones. The language and presentation in the book is simple and direct, yet retains accuracy and precision.

Chapter 1, by J. Gibson, is an introduction to the formation of coal and outlines its general properties. It is pointed out that, from the practical standpoint, the most important properties of coal are those associated with its behaviour when heated with or without the presence of air and that carbonisation still accounts for about 20% of the coal used in Britain. There is also an interesting diagram illustrating the total product yield of char, tar, liquor and gas as a function of the carbonizing temperature. The treatment of coal with solvents is also introduced in this chapter. Four types of solvent are noted, namely non-specific solvents, extracting only a few per cent of a coal at temperatures up to about 100°C, specific solvents, extracting 20–40% of the coal at temperatures below 200°C, degrading solvents, which extract up to 90% at temperatures up to 400°C, and, finally, reactive solvents which dissolve coal by reacting with it. The combined effect of heat treatment and solvent extraction offers much scope in the thermal analysis field. A further interesting point that is raised is the ability of some gases to act on solvents at high pressures.

The chapter by G.J. Pitt on the structural analysis of coal supplements the more general information provided in the earlier chapter. There is a special section devoted to the behaviour of coal on heating and an interesting application is given of the use of dilatometer data plotted against temperature, which provides information on structure. The dilatometer plots against temperature for the polycondensation products of pyrene and phenanthrene with formaldehyde allow comparisons to be made.

The process of carbonisation, discussed in some detail by J. Gibson, provides information at both a scientific and technological level. This is a field in which thermal analysis experiments can provide much valuable information. A simple classification of carbonisation processes is provided, namely, low temperature, between 450 and 700°C, medium temperature, between 750 and 900°C, and high temperature, between 900 and 1050°C. These temperature ranges effectively decide the character of the coke produced. Again, dilatometer data plotted against temperature provides some of the most informative data. It was in this field of coking that van Krevelen provided one of the earlier methods of kinetic analysis based on rising tem-

perature data and his scheme is outlined, namely

Coking coal → metaplast

Metaplast → semi-coke + primary volatiles

and

Semi-coke → coke + secondary gas

As this book is based on a series of lectures given by various individuals, there is inevitably a certain amount of duplication. The repeated emphasis on heat treatment occurs in all chapters and is again raised in Chapter 4, by G.J. Pitt, on Structure and Properties of Coal Derivatives.

There is an interesting section here dealing with the degree of parallel stacking of the aromatic layers which is shown to increase up to about 500°C coupled with a decrease in the proportion of amorphous material, substantiating the suggestion that, in the plastic stage, breakage of some chain-links occurs together with the evolution of lower molecular weight material. Between 500 and 700°C, Pitt points out that the layer diameter starts to increase while there is also a decrease in stack height. Over this temperature range, hydrogen is evolved and layers join up but layer growth is only achieved at the expense of the parallelism. Above 700°C, the layer diameter continues to increase and stack height increases again. Pitt is, of course, summarizing the extensive data produced in this field by Diamond and the informative schematic representation given by van Krevelen. Chapter 5, by G.R. Millward, describing the application of high-resolution electron microscopy to the study of the structure of coal-derived materials was not in the original eight presented lectures but provides valuable additional information, in particular with respect to the development of graphite structure in heat-treated coal and the manner of its variation according to origin.

Chapters 6–8 deal with three basic types of process on which development is now in progress to meet the requirements for fuel, power and chemical feedstocks. A.D. Dainton provides two of these chapters, one on the combustion and the other on the gasification of coal. The other chapter, on the Liquefaction of Coal, is written by J. Owen who also provides the final chapter on the Coal Tar Industry with special emphasis on new products from coal.

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