Acetylene

Its Properties Manufacture and Uses

S. A. MILLER

VOLUME 1

ACETYLENE

ITS PROPERTIES, MANUFACTURE AND USES

VOLUME I

S. A. MILLER

B.Sc., M.A., Ph.D., F.R.I.C.

ERNEST BENN LIMITED

LONDON · 1965

First published 1965 *by Ernest Benn Limited*
*Bouverie House · Fleet Street · London · EC*4

Printed in Great Britain

PREFACE

UNITS

IN DRAWING together fundamental scientific information, chemical engineering, and commercial data from a vast variety of sources, it was inevitable that difficulties with units should arise. Without being rigidly consistent, the overwhelming majority of the information in Chapter 1–7 has been quoted in or converted into metric units (cgs system), though the finer details of 'International System of Units (Bigg, *J.Roy.Inst.Chem.*, 1963, **87**, 407) have not been followed. Sometimes both metric and British units, one of them in parentheses, have been given, for example in respect of particle size, where the conversion from mm or microns to B.S. mesh is not straightforward. Where British or American *regulations* have been quoted, the units have not been converted. For Chapter 8, conversions would have given rise to many semi-absurdities, such as 6·35 mm pipe when a standard ¼ inch pipe was used, and either British and metric units have been used in this chapter, according to the source of information.

This, however, does not apply to temperature, where a change from Fahrenheit to Celsius seems to be in progress in Britain anyway. Fahrenheit temperatures are only given when they occur in documents of legal standing, and are designated °F. As all temperatures are given on the Celsius scale, except where absolute temperatures are used and are clearly shown as °K., it seemed superfluous to insert a C after the degree sign for each occasion when a temperature is given, and it must be understood that all temperatures in the text of this book (including Chapter 8) are on the Celsius scale unless otherwise stated. The designation °C. has been used in tables, for convenience of presentation. Rankine temperatures, °R., have been avoided (except in Fig. 2.4).

For pressure, the atmosphere has been preferred both to kg/sq.cm. and to bars. The units mm of mercury have been used without including the words 'of mercury' or writing mm Hg, simply as mm, and occasionally μ for 10^{-3} mm. One matter possibly not familiar to all readers is the use of atma for atmospheres absolute and atmg for atmospheres gauge. The micron (both as a pressure and as a linear measure) has been designated μ, and not (as is the most modern practice) μm (= micrometre); when not standing alone, μ indicates a 10^{-6} unit, as μg microgram. Space velocity has been abbreviated simply to hr^{-1}, when meaning cu.m. of gas at normal temperature and pressure per cu.m. of reactor volume per hour. Abbreviations of units are still not uniform even in the scientific literature, and such usages as cc (or ml) and cu.m. instead of the nowadays recommended cm^3 and m^3 should not cause the reader any difficulty.

REFERENCES

THE PRINCIPLE has been followed of giving the majority of the references consulted (as such, in translation, or as abstracts) in the preparation of this book (it has not been advisable to give *all* the references). This policy informs the reader both of the date and nature of the source for almost every item of information, and therefore should add to the value of the book; at the same time, of course, it enables the reader to follow through and obtain more information on such items as he is particularly interested in. Journal references give the page number on which the article consulted starts, rather than the page on which the particular item of information is referred to. Where pagination is not continuous through the year, the issue number has usually been given (in italics in brackets) rather than the month or week. Authors' initials have been omitted from the footnotes, but have been included in the name index. Where journals are particularly difficult of access, the reference with the author's name and initials will (in most cases) enable the reader who so wishes to locate an abstract, most frequently in *Chemical Abstracts*, or otherwise in *Physics Abstracts*, *Bibliographical Bulletin of Welding*, or some other abstracts journal as appropriate.

ACKNOWLEDGEMENTS

The author is grateful to the British Oxygen Company for permission to include material from the Company's publications and also some unpublished information. He also appreciates having been able to make use of the Company's information and ancillary services, and is grateful for the friendly advice and constructive criticism of many colleagues. It would be invidious to single out individuals, and all the help is hereby acknowledged.

The author and publisher acknowledge with thanks permission to use copyright illustrative material to the following owners:
Roggett & Co., *Acetylene*, 1.1, 1.5a, 1.15, 1.16 and 'British Acetylene and Welding Handbook', 1.3.
Macmillan Co., V. B. Lewes: 'Acetylene', 1.2, 1.4, 1.5b, 1.6, 1.8, 1.10, 1.11, 1.12
Foulton: '*Electric Furnace Conference Proceedings*', 1.7.
W. Knapp, Taussig: 'Die Industrie Des Kalziumkarbids', 1.9, 1.18, 1.19, 1.20, 1.21.
Aga Co., *NAG* Tidsskrift, 1.13 and 8.126, 8.127.
Swiss Acetylene Society, Keel, *J. de Soudure*, 1.14.
H.M.S.O., B.I.O.S. 1.22, 1.30, 1.31 and 5.26, 5.27, C.I.O.S. 1.23, 1.24, 1.25.
Reinhold Publishing Corporation, Nieuwland and Vogt: 'The Chemistry of Acetylene', 1.26 and Copenhaver and Bigelow: 'Acetylene and Carbon Monoxide Chemistry', 1.28, 1.29, 1.34.
Inter-Science Publishers Inc., 'High Polymers, Vol. 1', 1.27.
McGraw-Hill Publishing Co., *Chemical and Metallurgical Engineering*, 1.32.
University of Texas Publication No. 5011, 1.33.
Tothill Press Ltd., *Industrial Chemist*, 1.37, and *Mine and Quarry Engineering*, 3.16, 3.41.
Chemical Society of Japan, Kiyama and Teranishi: '*Rev. Phys. Chem. (Japan)* 2.2, 2.3; Tarama, Teranishi, Hattori and Miyazaki: *J. Chem. Soc. Japan*, 2.28, 2.29; Takigawa: *J. Chem. Soc. Japan*, 2.30; Kiyama, Minomura and Ozawa: *Rev. Phys. Chem. (Japan)* 2.35, 2.36, 2.37 and Ozawa: (*Rev. Phys. Chem. (Japan)* 2.38.
Butterworths Scientific Publication, Din: 'Thermodynamic Function of Gases', 2.4.
American Inst. Chem. Eng., Weber: *American Inst. Chem. Eng. J.*, 2.5 and 5.1, 5.2.
Akad. Veraggesellschaft Geest and Portiez, Weicherz, Bodea and Nord: *Z. Phys. Chem.*, 2.6, 2.7, 2.8.
Chemical Society, Tsiklis, Kofman and Shenderei: *Russian J. Phys. Chem.*, 2.9 and Khodeeva: *Russian J. Phys. Chem.*, 2.26.

Müszaki Könyvkiado Vallalat, Haidegger, Szebenyi and Sze kely: *Magyar Kem. Folyoirat*, 2.10.
American Chemical Society, Hogan, Nelson, Hauson and Cines: *Ind. Eng. Chem.*, 2.17; Pierson, Fletcher and Gantz: *Analytical Chemistry*, 2.31; Kastens and McBurney: *Ind. Eng. Chem.*, 3.20, 3.49; 5.6, 5.9 and Nedwick: *Ind. Eng. Chem.*, 6.16. and Bredig, *J. Phys. Chem.*, 3.1.
National Research Council, Cook, Lupren and Schneider: *Canadian J. Chem.*, 2.23.
Petroleum Publishing Co., McCurdy and Katz: *Oil Gas J*, 2.24, 2.25.
The Optical Society of America, Wiggins, Plyler and Tidwell: *J. Opt. Soc. Am.*, 2.32.
American Institute of Physics, Altshuller, and Wartburg: *Appl. Spectroscopy*, 2.33; Orlova: (*'Optics and Specstroscopy'*), 2.34; Iogansen and Kirkchi: 2.39 Atoji, *J. Chem. Phys.*, 3.2.
Berichte der Bunsengesellschaft, Muller and Kumpfmiller: *Z. Elektrochem*, 2.41.
Royal Society, Childs and Woodcock, *Proc. Roy. Soc.*, 2.42
Verlag-Chemie G.M.B.H., Goldman: *Chem. Ing. Tech*, 3.29, 3.31 and Kaess, 3.51.
Dunod, Aall: 'Etude du Carbure de Calcium Industriel', 3.3, 3.8, 3.9.
Verlag Johann Ambrosius Barth, Juza and Schuster: *Z. anorg. Chem.*, 3.5.
Minières et Metallurgiques, *J. Four Electrique*, 3.10, 3.11, 3.12, 3.13, 3.17, 3.18, 3.26, 3.33, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 3.42, 3.50
Christansen and Ydstie: *J. Iron Steel Inst.*, 3.22.
Springer, Durrer and Volkert: 'Die Metallurgie der Ferroleigierungen', 3.23.
Beavis: *Proc. Inst. Elec. Engr.*, 3.27.
Association Iron Steel Engineers, Kelly: *Iron Steel Eng.*, 3.28.
Chilton Co., Inc., Sem: *Iron Age*, 3.32.
German Standard Institution, DIN 53922, 3.45.
Electro-Kemiske, 3.25
l'Office Centrale de l'Acetylene et de la Soudeur, Analyser OCS 49, 3.47.
American Inst. Mech. Eng., *Electric Furnace Conference Proceedings*, 4.1a.
Ukrain. SSR Academy of Science, *Automatic Welding*, 4.13.
British Acetylene Association, 4.14.
British Welding Research Association, *Welding Production*, 4.31.
Iliffe & Sons Ltd, 4.32.
The Combustion Institute, *Combustion & Flame*, 5.4, 5.5, 5.44.
Chimica e Industria, 5.33, 5.34, 5.36.
Petroleum Refiner, 5.40.
International Chemical Engineering, 5.48.
Welding Journal, 8.52.
Welding Engineer, 8.53.
Welding & Metal Fabrication, 8.55.
L'Air Liquide Soc., Pamphlet, 8.56.
Missiles and Rockets, 8.58.
International Acetylene Assoc., *Bronzewelding*, 8.31.
Haynes: 'Stellite', 8.78.

'Welding Handbook', 8.79, 8.81, 8.83, 8.86, 8.87, 8.88. 8.97, 8.106.
American Welding Society, 8.80.
Engineer, 8.84.
Union Carbide Corp., 'Linde Tips', 8.125.

[*For complete list of illustrations see pages* xiv–xxiv.]

CONTENTS

CHAPTER 3

Calcium Carbide

CHAPTER 4

Acetylene from Calcium Carbide

CHAPTER 5

Acetylene from Hydrocarbons

CHAPTER 8

Fuel Uses

LIST OF ILLUSTRATIONS

CHAPTER I

CHAPTER 2