

# FORMULATION AND PRODUCTION OF CARBONATED SOFT DRINKS

Edited by A. J. Mitchell

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# **Formulation and Production of Carbonated Soft Drinks**

Edited by

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formerly of

Coca-Cola and Schweppes Beverages Ltd.

**Blackie**

Glasgow and London

Published in the USA by

**avi**, an imprint of

Van Nostrand Reinhold

New York

Blackie and Son Ltd  
Bishopbriggs, Glasgow G64 2NZ  
and  
7 Leicester Place, London WC2H 7BP

Published in the United States of America by  
AVI, an imprint of  
Van Nostrand Reinhold  
115 Fifth Avenue  
New York, New York 10003

Distributed in Canada by  
Nelson Canada  
1120 Birchmount Road  
Scarborough, Ontario M1K 5G4, Canada

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

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First published 1990

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**British Library Cataloguing in Publication Data**

Formulation and production of carbonated soft drinks.  
1. Soft drinks production  
I. Mitchell, Alan J.  
663.6

ISBN 0-216-92915-6

**Library of Congress Cataloging-in-Publication Data**

Formulation and production of carbonated soft drinks / edited by Alan  
J. Mitchell.

p. cm.

Includes bibliographical references (p. ).

ISBN 0-442-30287-8

1. Carbonated beverages. I. Mitchell, Alan J.

TP630.F67 1990

663'.62—dc20

89-29394  
CIP

## **Formulation and Production of Carbonated Soft Drinks**

## Preface

There is comparatively little published material on the technology of the soft drinks industry. The excellent house journals produced by the larger machinery manufacturers and the technical articles which appear in the magazines issued by bottlers' associations in every part of the world are of great benefit and interest to technical staff. However, there is a need for a basic book of reference which includes important aspects of the packaging of carbonated soft drinks; this particular sector of the industry has been chosen, not only because carbonated soft drinks vastly outsell all other soft drinks and mineral waters combined, but also because it is sometimes considered to be the most challenging area of beverage production.

In this book an attempt has been made to review the major stages of carbonated soft drinks production. There are chapters dealing with the composition and combination of the elemental constituents, the various primary packages and the many methods of protecting these packages during the distribution process. This extremely broad spread of activities has been compressed into one convenient volume, but the treatment is by no means exhaustive – each chapter could warrant a complete book in its own right. We have aimed to provide an integrated appraisal of the production of carbonated soft drinks. This book will give the newcomer to the industry an indication of the complexities of the various technologies employed and will provide a basis for experienced technicians who wish to specialise and become more proficient in a particular field. It will also assist soft drinks personnel who are employed outside the production sphere of operations – for example, those in the distribution, sales, marketing and financial departments who require an insight into the technicalities of the processing of soft drinks.

The subject matter concentrates on the production line and the general raw material of manufacture. The expanding segment of dispense technology has been omitted intentionally, since it is considered to be outside the scope of this volume. No specific chapter has been devoted to the legal aspects of the subject as these are so wide-ranging across continents that any cursory treatment would be unsatisfactory. Important restrictions by regulatory bodies on certain substances are mentioned, but it is vital that local enquiries are made to ascertain current controls, if any doubt exists.

Although written for the carbonated soft drink technologist, the book contains much information which will be of interest to other sectors of the beverage industry. In particular, details of primary containers, handling,

packing and packaging are also relevant to the wine, spirits, beer and non-carbonated soft drink industries.

My personal thanks are due to the authors who contributed the specialised chapters. They are all well-established experts in their field and give the reader not only the benefit of their experience but also an insight into possible future developments. As in any book of this nature, it must be made clear that the views expressed by the authors are their own and not necessarily the views of the companies which employ them.

I should also express my gratitude to my wife, Rose, and my son-in-law, Duncan, for their support and assistance in those areas of which they are well aware.

A.J.M.

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# 1 Introduction

A.J. MITCHELL

The colossal scale of the output of carbonated soft drinks worldwide is almost impossible to imagine. What is certain is that no one really knows the exact total consumption. Various estimates have been made: for example, Houghton<sup>1</sup> suggested a figure of 88 billion litres for the year 1979, rising to 102 billion litres by 1982. It would be wrong and too simplistic to extrapolate these figures to the present time, but we know from Hall's reliable statistics in Chapter 2 that the total consumption in the combined United States and European markets increased by 40% in the period 1978/88 and, applying the resultant annual growth rate of 3.4% to Houghton's latest figure, we obtain a world consumption of almost 130 billion litres for the year 1989. In view of the markets that have opened in the eighties, this is almost certainly a conservative estimate, but is sufficiently accurate to illustrate the extent of the present carbonated soft drink industry. If this total were consumed by the United States alone, then every man, woman and child would drink almost  $1\frac{1}{2}$  litres each day of the year – approximately triple the actual intake; applied to the United Kingdom, the equivalent figure would be an awesome  $6\frac{1}{2}$  litres per day. The instantaneous flow-rate of 130 billion litres per year is equal to 4122 litres every second which, if pumped, would require a pipeline over 2 metres in diameter. In monetary terms, the world market is worth in excess of £160 000m or over \$250 000m.

Having gained an appreciation of the magnitude of the carbonates market, it is equally fascinating to realise that over 40% of the total world output is consumed in Canada, USA and Mexico. Patterns of yearly per capita consumption vary enormously, with the USA an easy leader at 174 litres, and Mexico in a lagging second place at 97 litres – an example of two countries with quite dissimilar economies and yet the top two consumers in the world. The UK, at around 64 litres per person per year, does not even figure in the top ten, presumably due to the popularity of concentrated squashes, which are little known in most other areas of the world.

Assuming that carbonated drinks are readily available, with production centres established and the supply of raw materials organised, the factors which appear to influence per capita consumption are:

- personal wealth (disposal income)
- climatic conditions

- availability of an alternative liquid refreshment (drinking water supply)
- severity of liquor laws (licensing regulations and drink/drive restrictions).

Naturally, the sheer availability of any soft drink, coupled with aggressive and/or subtle promotional advertising, will have the desired effect in most markets. Even in the poorest countries, the acquisition of a soft drink is something of a status symbol as well as a means of enjoyment, however transient.

This huge market for carbonated soft drinks is therefore based on providing not only refreshment but also pleasure to young and old alike. Among the millions of fortunate consumers, only an infinitesimal fraction will have any idea of what comprises their favourite 'fizz', and even less notion of the technologies involved in ensuring that the drink is available to them in absolutely first-class condition. Even the formulation of the world's most popular carbonated soft drink remains a close commercial secret – but is still enjoyed millions of times a day in over 150 countries by trusting and satisfied consumers; such is the confidence and rapport that can be established in the supply of a premium product by an organisation committed to the pursuit of excellence, the raising of standards of community service and involvement in healthy sports.

It is not the product alone, however, which encourages and develops sales. The container and packaging must play their parts in safeguarding the beverage, and they must be appropriate to the intended outlets and afford maximum convenience to the consumer. Packaging technology during the past forty years has risen to these challenges by a series of major breakthroughs, interspersed with periods of refinement and improvement. The milestones are many and varied, including:

- development of palletisation, improving bulk handling in factories and warehouses
- introduction of plastic crates (replacing wooden boxes), encouraging standardisation and allowing automatic decrating, recrating and palletisation
- expansion and development of beverage cans and, later, easy-open aluminium ends of various designs
- introduction of non-returnable bottles, mainly for the supermarket business
- advent of multipacks with 'easy carry' facilities
- introduction of PET (polyethylene terephthalate) bottles, allowing larger capacities to be added to the container range
- application of plastic closures (for glass and PET) with superior sealing properties and tamper-evident facilities
- development of flexible packaging (shrink-wrapped trays) for cans and non-returnable bottles



All these and other developments have been pursued in conjunction with additions to the range of beverages: notably, low-calorie drinks with improved and more-acceptable artificial sweeteners, flavoured mineral waters, high-juice content drinks, fruit-flavoured colas, energy-inducing drinks and many more.

The microchip has effected the greatest improvement in the packaging of soft drinks in the last ten years. Individual machines (particularly those with many sequential operations which function on a 'cascade' arrangement) benefit from microprocessor control in the areas of fault-finding, performance-logging and reliability. Information from the various sectors of a production line may be collated to provide an overall assessment of line performance, obtained on a minute-to-minute basis and either screen-displayed or printed for a permanent record. These techniques may be applied to syrup room operation, raw materials ordering and control and the effective utilisation of mechanical and electrical services. The acquisition of management information in all areas of production is so conveniently accessible that the real danger is an excess of data which cannot be digested. Restraints must be applied to ensure that the right information is offered to the right people.

No one could claim that the soft drinks industry lacks enthusiasm for innovation; progress has been maintained in the years when economic difficulties and energy crises have followed each other in quick succession. Despite all these problems, soft drinks are generally cheaper today (in real terms) than 25 years ago, and this has been achieved by healthy competition, increased productivity, increased standardisation (leading to mechanisation) and a consolidation to faster, highly automated and efficient plants. In most developed countries, the soft drinks industries have undergone a polarisation in which larger organisations have increased in size (by combination or growth) and succeeded by means of large-scale, high-speed production, and the small-to-medium companies, with low overheads, have resisted the temptation to indulge in excessive expansion, remaining competitive in price and service in a prescribed area. Both types of operation can be successful in their own ways, and there is every reason to suppose that this basis for healthy competition will be the pattern for some years to come.

Two important aspects of packaging are energy conservation and ecology. Obviously these are interconnected and, within the soft drinks industry, attitudes vary enormously in different parts of the world. Clearly, the subjects may be touched upon only briefly in this volume and the influence of future developments will be mutually affected. A 'total energy' concept is required, taking into account all energy expended in the life of the package – not just during the treatment it receives in the soft drinks factory but also in the manufacturing and disposal operations. Recycling of containers achieves modest success in those areas where it is taken seriously. The move towards all-PET bottles (including the cap) and two-piece aluminium cans has improved the economic viability of recycling; the future introduction of PET