
1 Introduction

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1.1 BACKGROUND

Every living thing has a fundamental requirement for water, and as humankind developed, focus was always on access to reliable supplies of clean water from springs, wells and rivers. As populations grew and civilisation and technology evolved, there was inevitably an increase in the demand for water for domestic and industrial purposes; delivery systems were developed, as were the methods for treating water supplies effectively to ensure that they were safe for consumption, and to prevent the spread of diseases that could be carried by water to the general population.

However, although in most of the developed world there is a reliable supply of water, even with the benefits of modern water supply systems, some types of chemical treatment and the deterioration of pipes can cause organoleptic changes to municipal water, giving it an unpleasant taste. There are also concerns in many countries about potential (and in some cases, real) contamination of municipal supplies, and for these reasons amongst others, consumption of bottled water has steadily increased in both the developed and developing worlds. Furthermore, with the arrival of the unbreakable, resealable, lightweight polyethylene terephthalate (PET) bottle, providing the convenience of being able to consume a wholesome and refreshing drink at will, the consumer in many parts of the world has seized the opportunity to migrate from other beverages to bottled water.

In the light of this growing demand, the first and second editions of *Technology of Bottled Water* had as the principal objective to provide guidance on the legal and technical aspects to those requiring it (technical managers, packaging technologists, microbiologists). It was also deemed appropriate to give guidance to anyone wanting to understand the industry, and particularly those who were charged with the responsibility of regulation, whose own understanding of the industry was not always as complete as might be expected.

Finally, and perhaps most importantly, a key reason for the publication of the book was a general lack of practical information on what was then a relatively young industry in many parts of the world; it was seen as essential that new entrants to the industry were provided with at least a basic introduction to the complexities and potential challenges that they were likely to face. This was and remains particularly important at a time when many people with access to springs or groundwater supplies were avid to enter the industry, seeing it as an easy route to wealth. There was real concern that such new entrants might, in the absence of strong guidance, underestimate the real quality and food safety risks inherent in such a step, with consequential damage not only to themselves and their consumers, but also potentially

to the reputation of the industry as a whole. It was therefore seen as essential to present in one volume some practical and technical advice for those involved in (and those considering entry to) the bottled water industry.

This, the third edition, is being published at a time when the industry is at a decisive point in its development. As predicted at the time of the publication of the second edition, the bottled water market continued to grow, and the new markets (particularly in the Indian sub-continent, the Middle East and Far East) are still gaining momentum. However, in the developed markets, this growth has since slowed (to some degree as a direct result of the global recession), and the value of bottled water is also being challenged by activists who question its relevance and environmental acceptability. Nonetheless, bottled water continues to provide a convenient, healthy source of refreshment and hydration to those not wishing to consume other beverages. Indeed, it is also frequently called upon to be the sole source of potable water in times of emergency, whether simply as a substitute for municipal supplies undergoing periodic deviations from legal or safety standards, or as the only water available when a natural disaster strikes. Furthermore, bottled water companies the world over have long been conscious of the need to protect their sources, thus ensuring that they had a sustainable resource of high quality. Such environmental stewardship is in direct contrast to the claims sometimes made by critics, that bottled water companies are irresponsibly wasting natural resources.

Against this background, this book has been updated and continues to be a source of guidance for anyone wanting to bottle water safely. The third edition also contains two new chapters, of which the first covers the basic requirements for anyone considering developing or producing products in the category of flavoured or functional waters, and the second provides an overview of the work being done by the industry to address the environmental concerns, and to put into context the (actually very limited) impact of the industry.

1.2 THE THIRD EDITION

Although there have been some changes since the publication of the second edition, a major objective for the industry continues to be to find, protect and abstract good supplies of water, followed by filling and distribution to the ultimate consumer of a packaged product that meets all quality, safety and legal requirements. Increasingly also, some bottlers take waters of inconsistent and even of dubious quality (sometimes from private sources and sometimes from municipal supplies) and subject them to various treatments, often with the aim of producing water with a known and consistent composition.

By way of an introduction to the rest of the book, these developments and those of the product sector are covered in Chapter 2, which examines the development of the maturing bottled water market, taking into account historical and regional influences. Changes in packaging formats, reflecting lifestyle changes, and pressure from consumer groups are also shown to influence trends.

Different regions of the world continue to have a wide range of requirements and specifications for bottled water. This is examined in Chapter 3, primarily from the European and North American perspective, though the requirements for bottled waters in other markets are also covered. A part of this chapter also discusses the work done by the WHO/FAO Codex Alimentarius Commission in establishing worldwide standards for bottled waters.

The activities of man can be responsible for pollution of water, for example through agriculture, industry, road and rail construction, and special awareness and control is needed

to protect vulnerable groundwater from undesirable changes in quality when there is a requirement to bottle it without treatment. Chapter 4 describes the evaluation of groundwater sources, discussing varying geological influences. Development and protection of boreholes, and management of catchment zones and water yields, are also covered.

Water may come from various sources or supplies so, in many instances, treatments are used either for safety or legal reasons or to change the compositional quality of the water. Chapter 5 looks at the many options and possible reasons for choosing one or a combination of several treatment processes, although the choice available is always subject to local regulations.

The susceptibility of water to change, chemically, microbiologically or organoleptically, brings challenge to the bottling process. The inherent properties of water, the raw and packaging materials available and the equipment used all have profound implications for the safety and quality of the finished product that reaches the consumer. Chapter 6 looks at the potential impact of the choice of materials and the design and construction of equipment, and provides practical advice concerning the factors to be considered in order to protect the integrity of water throughout the process.

The ultimate objective for the bottler is to package the water in bottles, and although there are several different materials customarily used for bottled water, increasingly it is the ubiquitous PET bottle that dominates. Chapter 7, which covers product preparation and filling, also has a new section describing PET bottle manufacture and handling.

In view of the need for rigorous standards in good manufacturing practices, and more specifically for hygiene when dealing with bottled water, Chapter 8 deals with cleaning and disinfection, describing why and when this is needed. Cleaning-in-place methods and schedules, employee training and safe use of chemicals are also discussed.

Chapter 9 on quality management covers the principal programmes necessary for consistent high quality; areas of process control, in which operators undertake monitoring of quality parameters, as well as the more technical work performed in the quality assurance laboratory, are described. This section also covers food safety, in terms both of the action to be taken on the factory floor and also in evaluating risks throughout the entire supply chain. Hazard analysis critical control point (HACCP) remains central, but with the steady pressure from customers to establish more formalised systems for food safety, the use of standards such as ISO 22000 is also discussed.

Many offices and public places (and, increasingly in some markets, many homes) in densely populated areas, where the quality of municipal water is more affected chemically and organoleptically, have water dispensers, supplied through the 'Home and Office' channel. These dispensers, commonly called watercoolers, can incorporate facilities for chilled and hot water and in some cases, sparkling water. Although in some respects there are similar considerations to those for the retail sector, there are some additional priorities associated with their distribution, as well as the design of the dispensing equipment, all of which are discussed in Chapter 10.

Although companies producing bottled waters may adopt best practices for the industry, it is often the independent audit of the bottling process and systems used that give it credibility with customers and regulatory authorities. Chapter 11 sets out to detail the philosophy behind (and the steps taken during) the process of third-party auditing.

All bottled waters must be safe to drink and are required to be free from any pathogenic (disease-causing) micro-organisms. Some, such as natural mineral waters and spring waters, are required to be free from pathogens without treatment, and compliance with this requirement is monitored by testing for the absence of indicator organisms, as specified by

applicable legislation. On the other hand, some bottled waters, especially those originating from surface or municipal supplies, may be treated to kill any harmful bacteria and make them safe to drink; indicator organisms are again the means of monitoring this.

In the case of groundwater, there is also a natural population of indigenous harmless bacteria. In some markets, these naturally present bacteria are simply monitored to ensure that the normal condition of the water is not compromised; in others, it is a requirement that they remain within specified limits, both in the source and at the time of bottling. Thereafter, even though in still (non-carbonated) water, the number of these organisms grows logarithmically within days of bottling and can remain high for many months; these benign bacteria are not detrimental to the keeping quality of the water or to the well-being of the healthy consumer.

The difference in microbiological status between municipal or mains water and bottled waters is often used in alarmist articles in the media, where the two products are compared. Such a comparison is perfectly understandable and justifiable, but the assumption that the same qualitative standards apply to both products is not. All waters for consumption must be safe to drink. Municipal water achieves and maintains this status through chemical treatments and the presence of residual chlorine disinfection at the point of use. In the case of bottled water, such chemical residues are not only undesirable, as they impart an unpleasant taste and odour, but are also prohibited by legislation, as they contravene the 'standard of identity' of the product. The fact that bottled waters are usually governed by legislation different from that applied to municipal water demonstrates recognition by governments that these products are different. It is therefore no accident that both Chapters 12 and 13 discuss the subject of microbiology, one dealing with water bottled without treatment and the other for which treatment is used. Chapter 14, the first of the new chapters, entitled 'Formulation and Production of Flavoured and Functional Waters' – addresses the technology behind the growing range of products built upon the more traditional water base, and often used to extend brand recognition.

For very good reasons, there is an increasing awareness of environmental issues, and reputable companies include an environmental programme in their corporate agenda. Although the drivers towards this action can be legislation and consumer groups, it also makes good business sense to have sound environmental practice. As the industry continues to develop, much has been achieved in recent years to minimise the impact on the environment by improved manufacturing methods, rationalised distribution and reduction in packaging materials, for example by the light-weighting of containers. Chapter 15, on the 'Environment', is a considered examination of the factors of increasing concern for any modern producer, including raw material and energy use, waste and recycling, and provides some insight into the way these concerns are being addressed.

In publishing the third edition of *Technology of Bottled Water*, it is certain that the industry (which has matured significantly since the publication of the first edition) will continue to evolve and to play a major part in ensuring that consumers across the world have access to a convenient and safe supply of water, wherever they live, and regardless of the water type. Whatever the preference of the individual for style of consumption, bottled water will provide much needed nutriment and refreshment, and add to the pleasure and enjoyment of life.