

## Food and beverage:

# Filtration in the food and beverage industries

**I**n the second of his series of articles on the smaller end-use equipment application sectors, Ken Sutherland reviews the equipment marketplace for the processing and production of human and animal foodstuffs, and in the production of beverages, both soft and alcoholic.

The production of food and beverages is an important, although by no means the largest, component of the separation equipment market. A review of this sector must begin with a definition of its content, which, fortunately, is reasonably precise, involving little overlap with other sectors. The major anomaly lies in the production of drinking water, strictly the largest of the beverages, but in fact so large as to be in an end-use sector of its own, and therefore not included here. Minor classification problems would include the production of fermentation ethanol, as a fuel or as a beverage (or an industrial chemical), and the use of animal or vegetable fats and oils for industrial purposes.

The actual coverage by this article of the specific end-use applications is then as given in the following list, in the order used in the UK Standard Industrial Classification:

- Processing of meat, fish and their solid products (excluding oils and fats).
- Processing of fruit and vegetables and their solid products (excluding oils, fats and juices).
- Processing of oils and fats from animal and vegetable sources.
- Manufacture of dairy products (milk, cheese, etc).
- Milling of grain, and manufacture of cereal and starch products.
- Production of animal feedstuffs (*i.e.* food for husbanded animals, and domestic pets).

- Production of bread, sugar, cocoa and confectionary.
- Processing of tea and coffee.
- Production of beverages (alcoholic and non-alcoholic), including fruit and vegetable juices, and bottled mineral water.

Several of these sub-sectors are, of course, completely dry processes, but with a

sufficiency of liquid processing in the other parts, and of utility filtration (pneumatics, hydraulics and other operating services), enough to make this the fifth largest of the end-use sectors, utilising almost all kinds of separation equipment. The process filters and centrifuges are used in the preparation of ingredients, in the production process itself, in the purification of products, and in the recycling or treatment of waste streams.



Bottling of milk.





The cheese making industry is a major user of separation equipment.

### Global forces

As well as a period of intense economic turmoil, which, fortunately, seems to be moving into the past, the world is experiencing a number of circumstances that are impinging more or less directly on the food and beverage market. These include unacceptable levels of poverty and hunger in large areas (despite Millennium Development Goals and other worthy efforts, there are still over one billion humans living without enough to eat), which should be seen also in the context of the dichotomy between the poverty of the developing world and the increasing problem of obesity in the developed world.

The poverty problem is exacerbated by restrictions on agricultural land and fresh water availability, by competition between food and fuel demands for the land that is available, with consequent steep rises in the prices for staple foodstuffs (and even the buying by rich countries of fertile land in poorer regions, in order to safeguard food supplies), and the related problem of unsustainable forest clearances for the purposes of food production. There is growing concern in many areas over soil depletion, especially of the trace elements essential to good nutrition. The whole discipline of engineering is going to be severely stretched by the need to solve these global problems.

### Sector characteristics

There is a very wide range of liquid processes involved in the food and beverage sector, some with quite high intrinsic values, offering a wide range of separation processes. In many parts of it, this is a mature sector, with steady growth driven by increasing populations, and increasing standards of living in less well developed areas of the world.



Milling of grain and the manufacture of cereal and starch products requires filtration and separation techniques.

The rise in popularity of organic farming and food production has been prompted by concerns over safety, compared with the use of 'chemical' fertilizers and growth promoters. Other developments that are affecting the whole sector are:

- The appearance of 'functional' foods and 'energy' drinks to meet perceived human needs for personal improvement;
- The rapid growth in volume of convenience foods;
- The increasing awareness in the marketplace of better diets, and the provision of foods to match, applying especially to the sugar industry with a threat from 'artificial' sweeteners;
- The long threatened reduction in the food subsidies used to protect the agricultural sectors of the developed countries, so far without significant effect;
- The current concern over 'food miles', the distance foodstuffs have to travel, especially by air, to reach their markets, adding to their carbon footprint; and
- The need to control the dumping of food wastes to landfill, coupled with the excessive use of packaging materials (with the laudable objective of maintaining freshness) – yet another problem that is relevant to developed areas rather than impoverished ones.

One of the most important characteristics of the separation equipment used in the food and beverage industries is the need for it to be able to operate in a state of scrupulous cleanliness. Contact surfaces will normally be of polished stainless steel, and the whole equipment should be easily cleaned, preferably by some kind of clean-in-place process.

To offset this need for high quality materials of construction in food and beverage processing, it is mostly true that equipment for this sector does not have to withstand the severe





A food production facility in Norway.

processing conditions found in some chemical or pharmaceutical operations. Indeed the most severe operating parameters may well be those involved in steam sterilisation or an aggressive clean-in-place solution.

In the long term, the arrival of genetically modified food products onto the market may be the largest development in food provision for some time (or its largest problem, depending upon one's point of view).

### The corporate picture

In terms of corporate size, food manufacture has no companies to match the giants of other sectors. Although still by far the largest of the food producers, Nestlé, with annual sales in 2009 of about \$95 billion (well down on 2008), is only a quarter of the size of the largest petroleum companies such as Exxon or Shell. (There are, of course, food retailers much larger than Nestlé, especially Wal-Mart whose 2009 sales of \$400 billion made it the third largest company in the world in terms of turnover, with Carrefour a long way behind at second in the list of retailers, at \$130 billion).

The next largest company classified as a food producer is Unilever, with total 2009 sales of \$53 billion (although the Unilever picture is complicated by its extensive range of non-food household goods businesses). Unilever is closely followed by Cargill, the largest private company in the USA, and by Archer-Daniels-Midland, although both of these are large natural product commodity dealers as well. Then come ConAgra, Kraft Foods, Danone, Kellogg, General Mills, and H J Heinz.

For some time, the leading beverage companies have been the soft drink makers PepsiCo (2009 sales of \$43 billion) and Coca Cola (\$32 billion), some distance ahead of the brewers. This picture changed in 2008 with the purchase of Anheuser-Busch by InBev (itself the fairly recent merger of Interbrew and AmBev) to create a company larger than Coca Cola (although still behind Pepsi). Second in size of the brewers is now SABMiller (a 2002 creation), followed by Heineken and then Carlsberg.

Much fuss has been generated by the very recent acquisition by Kraft Foods of the

'British national treasure' Cadbury, to create a confectionery rival to Mars-Wrigley (another 2008 merger), each about twice the size of the confectionery business of Nestlé. Kraft, of course, was released back into the market by a demerger in 2007 from Philip Morris. Other food acquisitions include that of RHM by Premier Foods in 2007.

The beverage business has seen more takeover activity, headlined of course by the creation of the biggest brewer, Anheuser-Busch InBev, in 2008. SAB and Miller combined to form SAB Miller in 2002, Allied Domecq was acquired by Pernod Ricard in 2005, and Heineken and Carlsberg combined in 2008 to buy and dismember Scottish & Newcastle. Further consolidation in the beverage sector is being driven by a search for markets, because beer drinking can be very regional. Thus, Heineken has acquired the beer business of Femsa in Mexico – which holds 40% of its domestic market and nearly 10% of that in Brazil.

One of the fastest growing parts of the whole sector is the mineral water and soft drinks sector, which has a sizeable requirement for fine filtration. There is a wide disparity of consumption rates among the major countries – the French drink about 105 litres per head annually, but the British drink only 10 litres per head, the Japanese less than 5 litres, and the very populous countries of China and India hardly any at all. If all countries could increase to even half of the French level this would be a very exciting market for clarifying and polishing equipment.

### Filtration market size and trends

The estimated global sales volume, for the equipment used in filtration and related separations in the food and beverage sector in 2009, is estimated to have been around \$3.6 billion. (It is important to note that this figure includes all membrane process



The production of mineral water and soft drinks has a sizeable requirement for fine filtration.





Filtration processes are required in the production of wine.

applications, which form a major component of the market in this sector.)

This estimate covers both original equipment and the sale of spare parts. The sale of filter media, in bulk or as finished elements, to the makers of filters is not counted as a separate item, because such media sales are covered by the sales of the complete filters. Filter media sales are only included in the estimate where they are made directly to their end-user, as part of the supply of spares.

This figure of close to \$3.6 billion gives the sector about 7.5% of the total global market for these types of equipment, and puts it at fifth in order of the major end-use sectors, in a list that has bulk chemicals and petrochemicals at fourth, and fine chemicals and pharmaceuticals at sixth.

### Trends

This is not an easy time in which to be forecasting market trends, with the credit crunch and consequent recession only just moving behind us. The filtration industry is fortunate in being so widely represented and needed in the world's industrial and commercial activity, and particularly in the food and beverage sector. The products of this sector are obviously in continuing demand, and expenditure on them will continue while that on less essential goods and services may be more profoundly affected.

It can confidently be said, therefore, that the rate of growth of the food and beverage sector's filtration equipment market will continue to be 2-3% above the general rate of economic growth. This still means that, as a result of the recent economic recession, 2009 will have shown no real growth over 2008, although the market will return to growth in 2010, with a real, uninflated figure of about 2% in 2010, climbing back to 6 or 7% by 2013.

This growth will continue to be driven by the increasing demands for finer filtration.

### Equipment applications

It is probably true that every possible type of filter, centrifuge or sedimentation system is in use somewhere in the world on some process within the food and beverage sector. Some characteristic food and beverage applications include:

- The use of basket centrifuges in the production of salt;
- The separation of cream from milk in a disc centrifuge – for which this type of centrifuge was invented;
- The further purification of water by membranes to serve as a food or beverage ingredient;
- The use of a rotary vacuum drum filter in the separation of sugar juice from settled-out muds, followed later by a 'sugar centrifugal' to recover the crystallised product;
- The purification of starch in batteries of hydrocyclones, which provides one of the key uses of the hydrocyclone;
- The refining of vegetable seed oils, after washing with water, in an array of tubular or disc centrifuges, followed, usually, by winterising (dewaxing) in vacuum filters; and
- Among many separation activities in a brewery or a distillery, the dewatering of separated grains in a filter press or decanter centrifuge, and the clarification of the product in a sheet filter.

In addition, there is the need in most food and beverage factories for the treatment of often very concentrated liquid wastes, requiring the full gamut of treatment

stages, from oil and grease separation (in a lamellar separator), followed by primary settlement (in large sedimentation tanks), then secondary activated treatment (in aerated tanks) with separation of the surplus sludge in a filter or another settlement tank. The process will then finish with tertiary treatment, possibly a biological one, or, increasingly commonly, a membrane micro- or ultrafiltration stage, to deliver recycled water of a similar standard to the fresh ingredient water. The secondary stage is increasingly being undertaken in a membrane bioreactor.

### Market prospects and opportunities

Many of the factors discussed so far in this article suggest business opportunities for the separation equipment business. Among the key ones are:

- The expansion in use of genetically modified foods, once the resistance to their use has been overcome – this will change processing methods in a number of ways;
- The undoubted benefits of nanotechnology (not least the heightened sensations of taste and flavour of materials in nanoparticle sizes), yet to be sufficient to overcome concerns over their use; and
- Demands for food and beverage supplements, for dietary and health reasons, causing the food and beverage sector to take on pharmaceutical appearances.

One of the key thrusts from discussions (and a few actions) on global warming abatement, coupled with a realisation of global resource shortages, has been the recognition of the need for the whole world to work towards a more sustainable lifestyle. Sustainable development of land and water resources will be a problem for most countries, in a future where forecast population growth will outstrip mankind's present ability to feed itself.

The need for sustainability, in production and consumption, implies some limitation of expansion. Other limits will be set by regulation and the imposition of standards to prevent mankind's natural inclination to overreach for available resources. ●

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