OZONE FOR BOTTLING APPLICATIONS

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Abstract

Over the last decades there has been an increasing demand for water in bottles, cans, etc.. This demand or trend, which has many reasons beyond the scope of this paper, has drawn manufacturers' attention to the necessity for specialised filling techniques. One particular problem that plagues the bottled water industry is the microbial quality of the bottled products. In the more recent past, public attention has been drawn by various articles referring to this growing problem that affects well known and lesser known bottled water companies alike.

Introduction

Beverage filling plants are quite complex in their construction and, in the main, are made up from the following plant components:

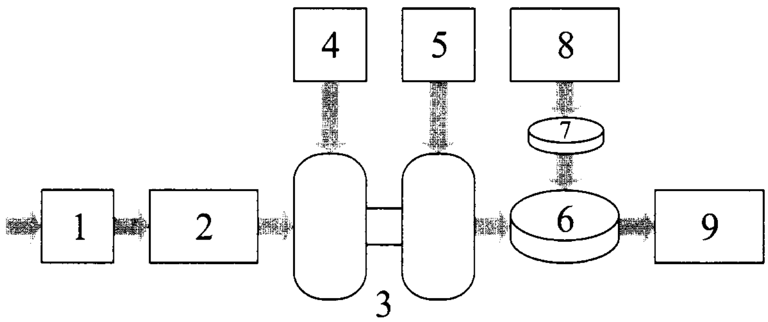

Fig. 1 Basic diagram of a Filler line

1	Influent treatment	6	Filler
2	Process water treatment	7	Bottle washer
3	Mixer	8	PET bottle blower
4	Syrup / concentrate	9	Crating & storage
5	Carbonisation		

Because of the relatively large investment involved, operators are compelled to arrange their facilities so that they can fill as many different beverage products as possible. Not only must the operators make the most of the bottling equipment, they also have to comply with stringent regulations relating to food-stuffs and show a very active interest in order to warrant that their products are of high marketable quality with a long shelf life.

In addition to the careful selection of the product’s ingredients and storage containers (bottles, cans, etc.), filling companies take further measures to ensure that the product quality remains unchanged after extended periods under typical storage conditions found in distribution centres and retail outlets.

An important step towards product quality is to maintain a high level of hygiene throughout production. This not only applies to the filling equipment and surroundings, but also to the product ingredients themselves.

One of the main reasons for low product quality with a compromised shelf life is microbial contamination - extensive precautions must be taken to prevent this. A standard procedure for filling soft drinks, in addition to the normal plant hygiene, would be to disinfect the ingredients and the product receptacles prior to filling. At the time of writing, the author has no information concerning a disinfectant or sanitising agent that can be mixed in with the product without having an adverse effect on the organoleptic properties of the beverage.

However, the situation regarding disinfection is completely different when it comes to the various types of unflavoured table waters.

Use of ozone when bottling water

As previously mentioned, cleanliness is an important factor to enhance product quality. In the past, bottling water plants have relied on high hygiene levels in conjunction with chlorine or chlorine based products for sanitation. Nowadays, more and more bottling companies are relying on the use of ozone to meet the ever increasing legislative and consumer demands. There are 2 possibilities to use ozone when bottling drinking water:

- Ozonation of the washing water used to clean the bottles prior to filling
- Ozonation of the actual product water

Bottle washing

It is obvious that the purpose of washing is to clean the bottles before filling. Basically, there are 2 types of bottles extensively used these days:

- The PET type bottles that are freshly blown immediately prior to filling. Although these are new, operators must subject the bottles to washing in order to remove any possible mechanical debris.
- Reusable glass bottles that have to be intensively cleaned so that all debris and any possible residues from the previous filling are completely removed.

Typically, the washing process for these bottles involves the insertion of a nozzle into the inverted bottle through which a high pressure jet of water thoroughly cleans the inside surface of the bottle of all mechanical debris, deposits, etc.. In addition to this mechanical cleaning, filling companies require that this cleaning also disinfects the bottles in order to avoid microbial contamination after the filling and capping of the product. To achieve this effect it is standard practice to add a relative amount of chlorine, or one of its derivatives, to the wash water.
It is thinkable to use ozone for this sanitation process, however, attention must be given to the fact that the ozone will be driven out of solution by the "splashy" nature of the cleaning process. Bearing this in mind, special measures must be taken to prevent

unacceptable levels of ozone building up in the ambient surrounding the filling machine.

Product ozonation

Fortunately, for ozone generator manufacturers and bottling companies, there is a second possibility that guarantees a very high product quality, that is the ozonation of the product water.

Experience has indicated that a small dose of ozone, in the region of 0.3 mg/1 to 0.5 mg/l, is sufficient to sanitise the product and the product packaging. After filling the ozonated product, the crated or palleted bottles are placed on stock for a few days in order to allow the ozone to decompose. After this period, the ozone will have oxidised the organic substances in the product water, the microbial activity will have been reduced to a minimum (or even sterility) and the remaining unreacted ozone will have decayed to form diatomic oxygen.

There are several concepts concerning how to introduce the ozone to the product, each of which has differing merits depending on the type of filling plant. Following are 3 examples of ozonation systems that have proved very satisfactory in service:

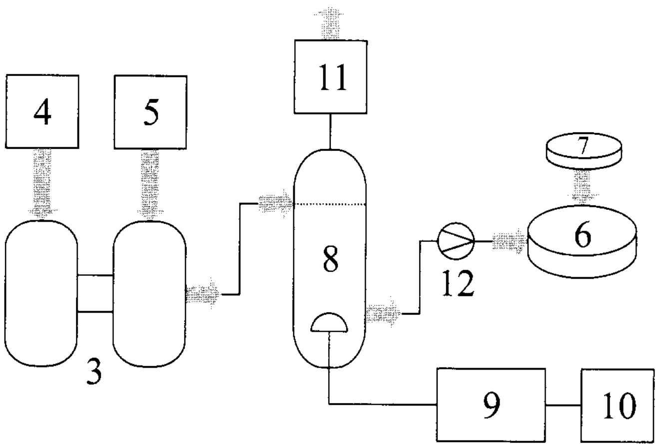

Fig. 2 Filler line with ozonation and atmospheric contacting system

3	Mixer	8	Contact chamber
4	Syrup / concentrate	9	Ozone generator
5	Carbonisation	10	Feedgas unit
6	Filler	11	Vent ozone destructor
7	Bottle washer	12	Pump

This arrangement has shown excellent results and is particularly suited to the smaller applications with fewer plant components. Attention must be given to the fact that the ozone mass transfer takes place in a virtually pressureless chamber that allows cost effective porous diffusers to be used. However, it does mean that any pressure in the system before the contacting volume will be reduced and that a relatively expensive contact chamber (approximately 6m high) must be incorporated in the design.

A second alternative is shown in figure 3. Although this system avoids a pressureless contacting system, and the consequent wasting of energy in the form of pressure reductions, it requires more components such as: motive water pump, gas injector and automatic degassing valve on the contact chamber. Another advantage is the fact that the high contact chamber shown in the previous example (figure 2) can be replaced by a unit only 2m to 3m high which is of particular interest where height is limited.

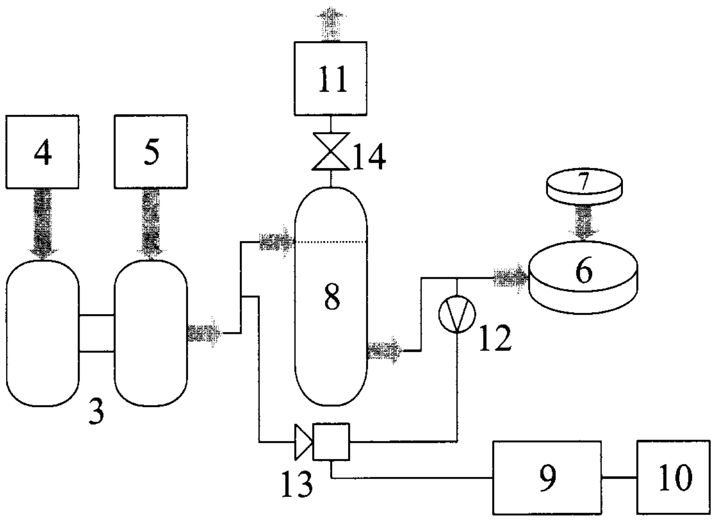

Fig. 3 Filler line with ozonation and atmospheric contacting system

3	Mixer	9	Ozone generator
4	Syrup / concentrate	10	Feedgas unit
5	Carbonisation	11	Vent ozone destructor
6	Filler	12	Motive water pump
7	Bottle washer	13	Injector
8	Contact chamber	14	Auto degassing valve

A third example of an ozone contacting system is shown in figure 4. This is probably the most practical solution because it does away with the necessity of having a contact volume.

In effect, the product is ozonated with the prescribed, or established, dose by an injector system located between the mixer and the filling machine. Instead of having a designated contact chamber, this system utilises the volume of the filler bowl and/or the actual volume of the bottle being filled thus saving an expensive food grade contact chamber. Additionally, the arrangement shown in figure 4 also incorporates a bypass feature that makes it ideally suited to the start-stop type of operation found in filling plants.

As with the injector system depicted in figure 3, this system also requires a certain amount of components. However, with correct engineering and design work this slight disadvantage is easily turned into a major plus for the filling companies.

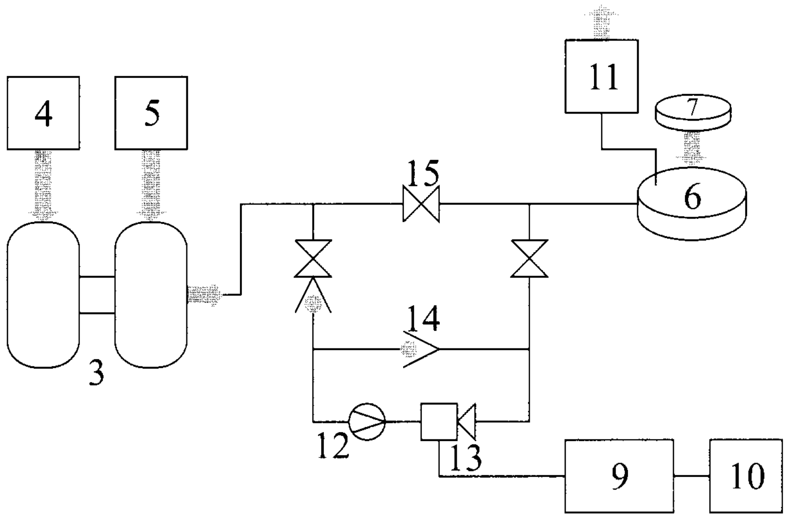

Fig. 4 Ozonated Filler line without a contact chamber

3	Mixer	10	Feedgas unit
4	Syrup / concentrate	11	Vent ozone destructor
5	Carbonisation	12	Motive water pump
6	Filler	13	Injector
7	Bottle washer	14	Bypass valve
9	Ozone generator	15	Valve assembly

Ozonation of the product has the added advantage for the operator that he does not have to modify his bottle washing equipment - in fact, bottling companies could even omit the disinfectant in the rinse water when filling unflavoured beverages.

Conclusion

Treatment with ozone only produces "oxygenated" by-products and oxygen. This property makes it ideal for applications in the food-stuffs industry because it results in a product that is better in quality with regard to taste and odour and is actually healthier for the consumer.

Keywords

Ozone - table water - sanitation - disinfection - bottle washing - product ozonation.

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