NATSURV 3

WATER AND WASTE-WATER MANAGEMENT IN THE SOFT DRINK INDUSTRY

WATER AND WASTE-WATER MANAGEMENT IN THE SOFT DRINK INDUSTRY

Prepared for the

WATER RESEARCH COMMISSION

By

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FOREWORD

The need for guidelines to reduce water intake and to promote better management of waste water by industry is in the national interest in view of South Africa's water scarcity.

To establish norms for water intake and waste-water disposal, the Water Research Commission (WRC) in collaboration with the Department of Water Affairs (DWA) contracted Binnie and Partners, a firm of consulting engineers, to undertake a National Industrial Water and Waste-water Survey (NATSURV) of all classes of industry. The results obtained in the survey of the soft drink industry form the basis of this guide on **Water and Waste-water Management in the Soft Drink Industry.**

It is expected that this guide will be of value to the industry itself and to other interested parties such as municipalities, legislators, researchers and consultants in the water and effluent fields.

ACKNOWLEDGEMENTS

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Their contributions to the project are gratefully acknowledged.

SUMMARY

Transport costs have resulted in soft drink manufacturing plants being situated in the majority of large towns in South Africa. Thus, there are numerous carbonated soft drink bottling/canning plants, dairies and several fruit juice packaging plants which collectively produce approximately 1,5 million m^3 of soft drink a year (85% from carbonated soft drink bottling/canning plants, 10% from dairies, 5% from fruit juice packaging plants). This requires approximately 4,0 million m^3 water of which between 50% and 80% is discharged as effluent.

The average Specific Water Intake (SWI) was found to be 2,7 m^3 water per m^3 of soft drink. Improvements in SWI can be achieved through implementation of water saving/reclamation techniques and improved water management. The target SWI should be set at 2,3 volume/volume.

The average Specific Pollution Load (SPL) was found to be 4,0 kg COD/m^3 of soft drink. A reduction in SPL can be achieved by improved management and by effluent treatment processes. The target SPL for untreated effluent should be set at 3,5 kg COD/m^3 soft drink.

The target for TDS should be set at 5 kg TDS/m^3 soft drink for plants with bottle-washers and 1,5 kg TDS/m^3 soft drink for plants without bottle-washers.

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BRIX - The percentage of sugar in a solution by weight.

SPECIFIC EFFLUENT VOLUME - The effluent volume for a particular period divided by the product volume for the same period (volume/volume).

SPECIFIC POLLUTION LOAD - The mass of given pollutant for a particular period divided by the product volume for the same period (mass/volume).

SPECIFIC WATER INTAKE - The water intake for a particular period divided by the product volume for the same period (volume/volume). This can be regarded as litre of water/litre of product.

ABBREVIATIONS

ACL - Applied colour label

CIP - Cleaning in place

CO_2 - Carbon dioxide

COD - Chemical oxygen demand

NaOH - Sodium hydroxide/caustic soda

NRB - Non-returnable bottle

OA - Oxygen absorbed

SEV - Specific effluent volume

SPL - Specific pollution load

SS - Suspended solids

SWI - Specific water intake

TDS - Total dissolved solids

1 INTRODUCTION

Soft drink production presently accounts for an approximate annual water consumption of 4,0 million m^3. The current total soft drink output is in the region of 1,5 million m^3/year.

The forty carbonated soft drink bottling/canning plants in South Africa (1987) produce 85% of the total soft drink output. These are regionally located as follows:-

Transvaal	- 15
Natal	- 8
Cape Province	- 14
O.F.S	- 3

The remaining 15% of the market share is in the form of fruit juices, two thirds of which is produced in dairies countrywide and is further discussed in the guide to Water and Waste-water Management in the Dairy Industry. The remaining third is produced in three fruit juice packaging plants.

There are large variances in the percentage of water intake discharged as industrial effluent. This fact is due to the varying nature of products and processes, to whether bottle-washers are used, and to the degree of water reclamation practiced. Generally anything from 50% to 80% of water intake is discharged as industrial effluent. This may account for up to about 2,8 million m^3/year of waste-water discharge which contains mainly sugars, sodium hydroxide and detergents. Effluent of this nature causes undesirable pH levels and high solid and organic loads. Since very few soft drink plants have on-site waste-water treatment facilities, municipal treatment works have to deal with the majority of this polluted effluent.

The soft drink industry in South Africa is significant both from a water intake and an effluent discharge point of view. The information used for this guide has been collected from detailed surveys of twelve different plants mainly situated in the Transvaal region. A further thirteen plants were surveyed by post and telephone.

2 PROCESS RESUMÉ 1

2.1 Definition

A soft drink can be described as a non-alcoholic carbonated or non-carbonated beverage. Their production essentially involves the blending of a concentrate and additives with water. The manufacture of carbonated and non-carbonated soft drinks uses different processes and therefore will be treated separately.

2.2 Major steps in the production of carbonated soft drinks

A typical manufacturing process flow chart is shown in Figure 1. Processes vary slightly from plant to plant but are essentially the same and include:

- water treatment;
- simple and final syrup mixing;
- bottle-washing (returnable bottles);
- carbonating, blending and bottle filling;
- capping/crowning and packaging.

2.2.1 Water treatment

The incoming industrial water that is to be used as product water (also called treated water) is treated to improve its overall quality. Again, systems may vary from plant to plant but the water treatment system generally used is described in Figure 2. The incoming water is initially disinfected after which chemicals are added to remove alkalinity and to aid flocculation and settlement in the clarifiers. The sand filters remove suspended matter and finally activated carbon filters are used for the removal of taste, colour and odours as well as any excess chlorine and organic matter. The treated water is used in the product, for cleaning in place (CIP) and in ther areas where water of high quality may be required.

2.2.2 Simple and final syrup mix

The simple and final syrup mixing stages involve the manufacture of the final syrup which accounts for approximately 15-20% of the final product. The simple syrup mix involves the dissolving of sugar (55-65% by weight) in water after which the flavourings, colouring, acids, preservatives (making up the beverage base) and more water are added and blended to form the final syrup mix.

Figure 1 Typical process flow diagram illustrating the manufacture of carbonated soft drinks

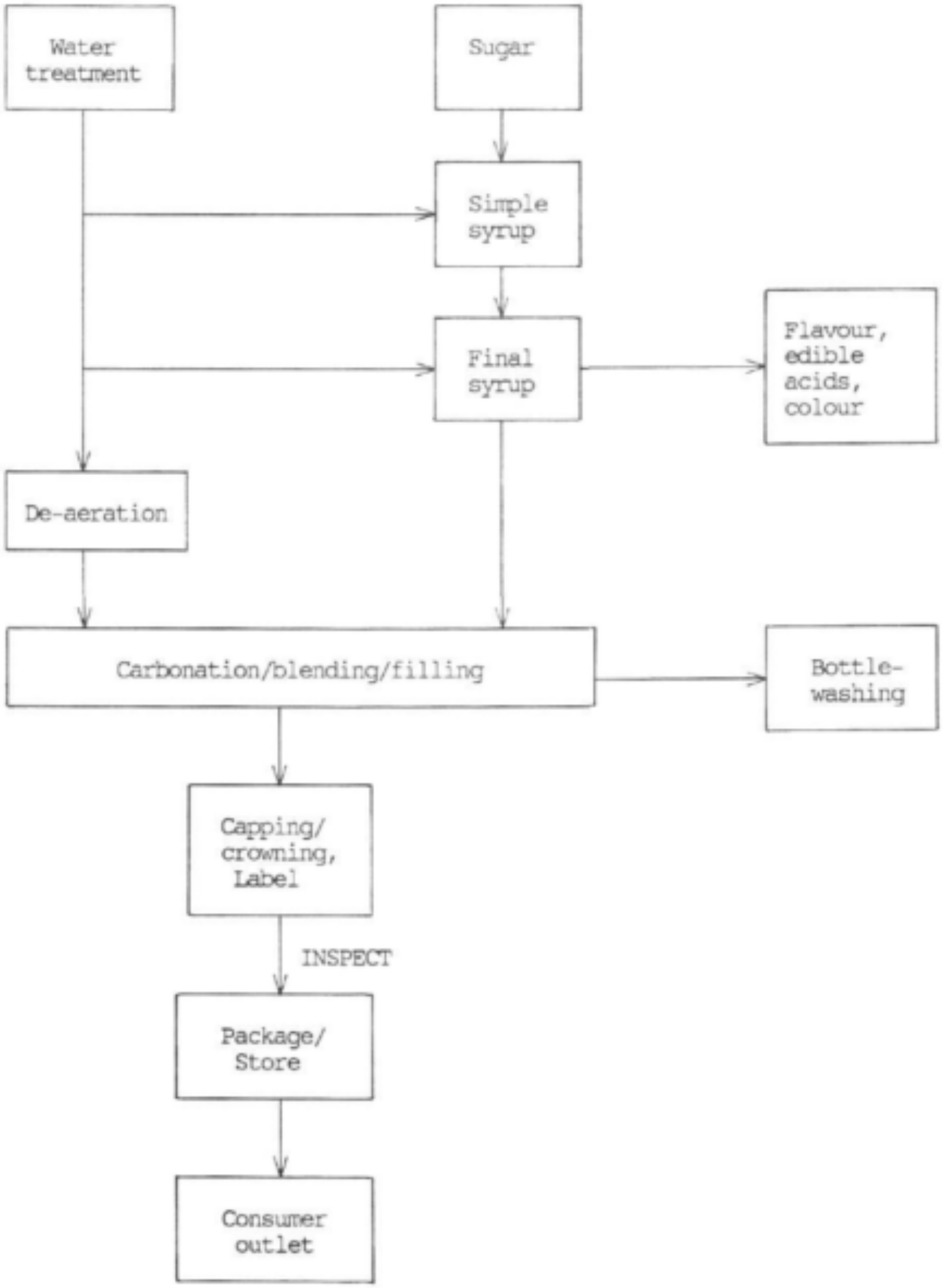
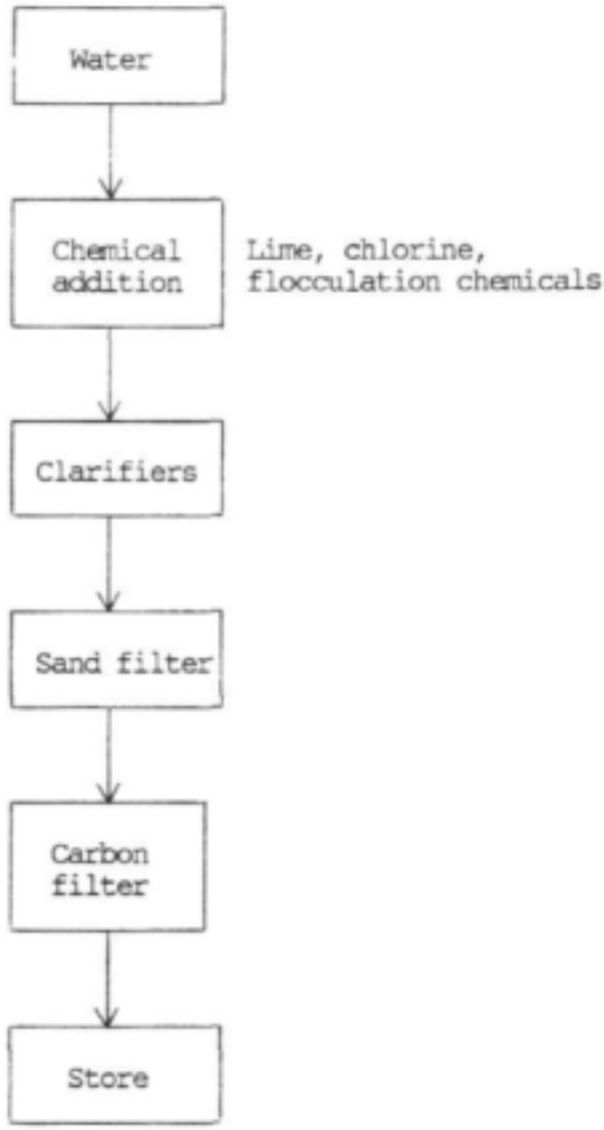


Figure 2 Typical flow chart for water treatment



2.2.3 Carbonating, blending and filling

Product water is usually de-aerated and then carbonated before it is proportionally blended with the final syrup to the required concentration.

2.2.4 Capping, crowning and packaging

The bottles are sealed with caps or crowns and if necessary labelled. Canning plants utilise seamer machines which seal the cans. The final product is then inspected before being packed in crates which are in turn placed on wooden pallets. The product is then stored until distribution to the retailer.

2.2.5 Bottle-washing

In some cases, the washing of returnable bottles can use up to 50% of a plant's total water consumption and thus it warrants detailed attention. Figure 3 describes how the bottle-washing process takes place (overpage):

(a) **Pre-rinse** - Incoming bottles are rinsed in the inverted position with "used" rinse water from the pre-final rinse section to remove foreign matter or remnant liquid and to warm the bottles.

(b) **Caustic soak** - The bottles are soaked in a strong solution of sodium hydroxide (2-3%) at a temperature of approximately 60° which removes the remaining dirt particles and eliminates bacteria. There may be a number of soak tanks.

(c) **Caustic drain** - The bottles are inverted and allowed to drain off caustic.

(d) **Pre-final rinse** - The bottles are rinsed with "used" water from the final rinse section.

(e) **Final rinse** - Fresh water is utilised in the final rinse section.

The bottle-washing process is in itself fairly efficient in the way that final rinse water is reused as pre-final rinse water and then as pre-rinse water before being sent to drain (see Figure 3). The caustic solution is also recycled in some cases, to maximise its use. However, an average sized bottle-washer uses approximately 15 m^3 water per hour and bottling facilities can contain up to 5 bottle-washers. Up to 85% of the final rinse effluent can be reclaimed and recycled. This is the 85% indicated in Figure 3 and further discussed in Section 4.1.3(a).

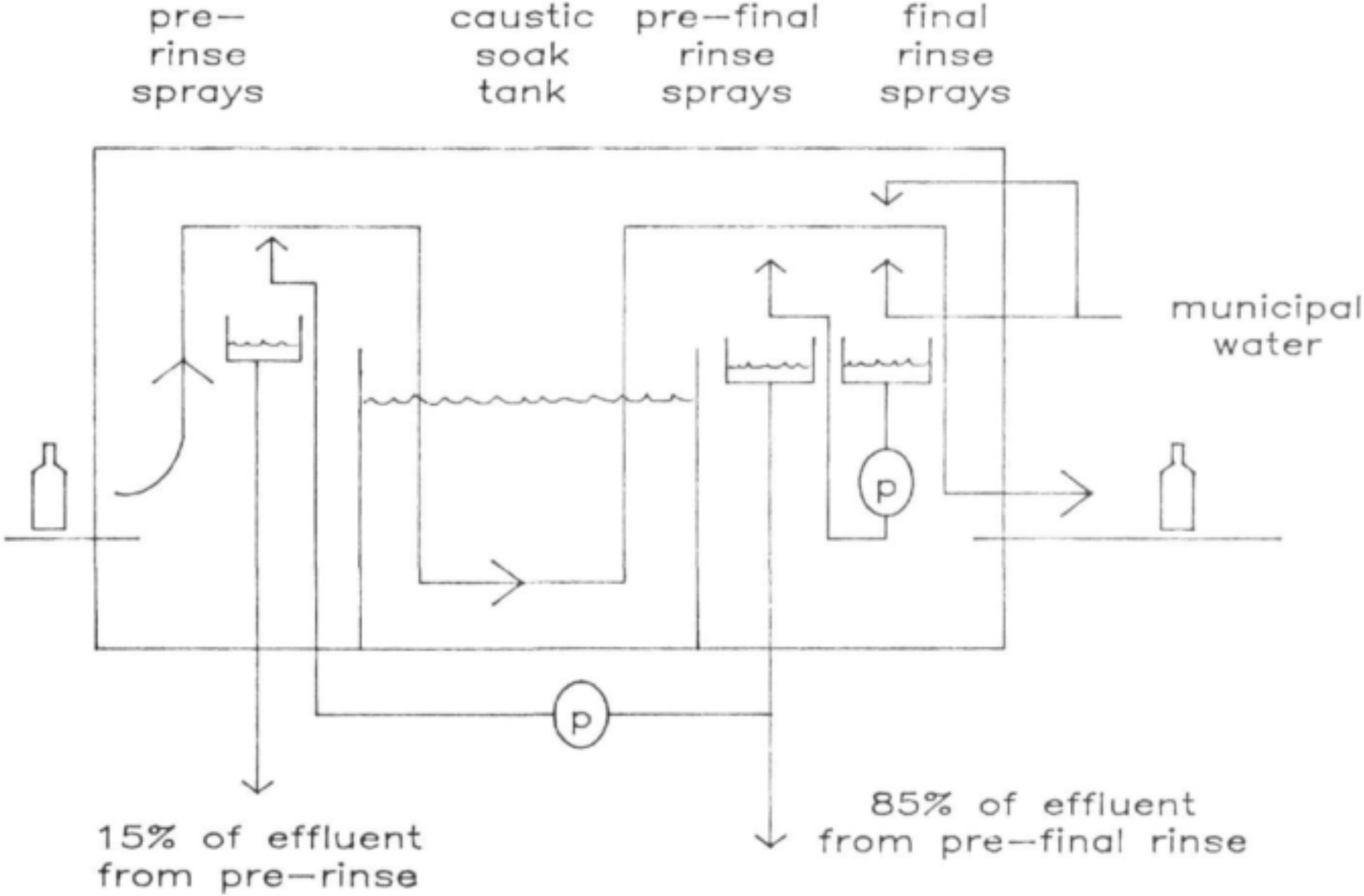
2.3 Major steps in the production of non-carbonated soft drinks

The manufacture of non-carbonated fruit juice soft drinks is a simple process of blending fruit juice concentrate and additives with water. A typical process flow chart is shown in Figure 4 and involves:

- blending;
- pasteurising;
- filling/packing.

Figure 3

SIMPLIFIED DIAGRAM OF A BOTTLE-WASHER
SHOWING THE FLOW OF WATER AND BOTTLES



It must be noted that the fruit juice concentrate is regarded as a product of the fruit and vegetable industry. Information concerning its manufacture can be found in the Guide to Water and Waste-water Management in the Fruit and Vegetable Industry.

2.3.1 Blending

The fruit juice concentrate (sometimes pureé), water (dechlorinated municipal water), sometimes acids and sugar are batch-blended to the manufacturer's specific recipe. Use is made of mechanical mixing to ensure complete blending.

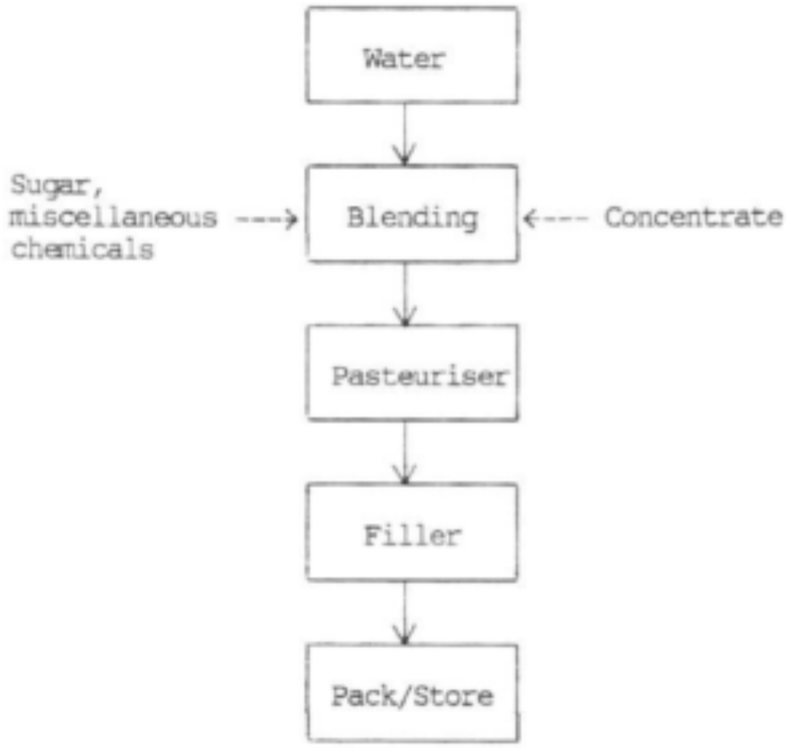
2.3.2 Pasteurising

The mixture is passed through a pasteuriser where the heating and cooling process kills off the micro-organisms. Equipment utilised in pasteurisation often uses a large volume of water which can possibly be recycled and is discussed in Section 4.1.2.

2.3.3 Filling/Packing

The product is pumped from the pasteuriser to the filling machine whereafter the packaged product is then stored until distributed to the retailer.

Figure 4 **Typical process flow diagram illustrating the manufacture of non-carbonated soft drinks.**



3 SUMMARY OF SURVEY RESULTS

3.1 Water intake

The specific water intake (SWI) parameter gives a good indication of the water efficiency of the production process. A summary of survey results are shown below in Table 1.

Table 1 - Specific water intake of soft drink factories

Factory	Average soft drink production (m^3/month)	Average water intake (m^3/month)	SWI
A	6 200	21 600	3,5
B	5 100	19 533	3,8
C	6 700	15 000	2,2
D	8 160	10 608	1,3
E	4 800	10 560	2,2
F	2 925	10 357	3,5
G	3 525	9 776	2,8
H	3 500	7 350	2,1
I	2 898	7 245	2,5
J	1 200	6 360	5,3
K	2 600	6 000	2,3
L	2 560	5 900	2,3
M	2 096	5 240	2,5
N	2 057	4 875	2,4
O	1 860	4 650	2,5
P	1 688	4 500	2,7
Q	1 684	4 210	2,5
R	1 528	3 920	2,6
S	1 394	3 670	2,6
T	786	3 509	4,7
U	1 530	3 185	2,1
V	1 130	3 080	2,7
W	1 000	2 900	2,9
X	650	1 780	2,7
Y	588	1 400	2,4

Points to note in relation to this table:

(a) The results are for all types of soft drink manufacture (carbonated and non-carbonated).

(b) Soft drink production has a definite seasonal peak and the figures shown are the averages for a one-year period (1986-1987).

(c) Results are listed in descending order of water intake.

(d) The average SWI is 2,7.

(e) The weighted SWI is 2,6 which indicates that the varying size of plants does not noticeably affect the water efficiency.

(f) The degree of bottle-washing carried out can affect the SWI results as shown in the low SWI result obtained for factory D where no bottle-washing takes place.

(g) Regional variations are evident as shown in results for factories J and T which are located in the Cape where no water restrictions prevailed for the period under discussion.

3.2 Breakdown of water use

For the purposes of this guide the major water-intensive sectors of a soft drink factory are:

(a) process water (in product and CIP);
(b) bottle-washing (carbonated soft drinks only);
(c) washdown water;
(d) utilities (boilers, cooling, ablutions).

Taking a typical SWI of 2,7 and dividing it between the basic divisions and averaging the results obtained from the surveys, the following has been obtained:

- process : SWI 1,08 (0,25 of this is contributed by backwashing of process water treatment plant).
- bottle-washing : SWI 0,95
- washdown : SWI 0,54
- utilities : SWI 0,13

(a) **Process water** - All soft drinks consist primarily of water (about 75-95% by volume). The SWI for the process water was generally constant and was found to range from 0,9 to 1,1.

(b) **Bottle-washing** - The SWI for this area showed extreme variations for those factories with bottle-washing facilities. These variations are due to the number of washers; size, age and make of washer; size of bottles being washed; and most importantly, whether a rinse-water recycle system (see section 4.1.3 (a)) had been implemented. The SWI variation for this area was found to be 0,3 to 1,3.

(c) **Washdown** - A large percentage of the water intake is used in the washing of floors and machinery. Also, because the same machinery and equipment are used for the production of a variety of different flavours of soft drink, it has to be thoroughly washed for each brand change-over in order to prevent contamination. A CIP system is normally used for these washing processes and the number of change-overs accounts for the variance in SWI. The SWI variation for this area was found to be 0,4 to 0,7.

(d) **Utilities** - This area covers the ablutions, boilers, cooling system, vacuum pumps and compressors and consumes a relatively small percentage of the water intake. However, results show that the smaller the factory, the greater the importance of water consumption with regard to utilities. The average SWI for this area was found to be around 0,13.

3.3 Effluent

There are large variances in both the quantity and quality of effluent produced by the manufacture of soft drinks. Quantity is proportional to fresh-water intake but is greatly influenced by both the nature of the process and product, bottle-washing, backwashing, rinse-water reclamation and management practices. The quality of effluent is in turn often influenced by a reduced water intake (increased concentration), bottle-washing techniques (if any) and again, the varying nature of the process.

Table 2 lists a summary of results of chemical analyses performed on composite samples taken from various soft drink factories' final effluent streams.

Table 2 - Summary of effluent chemical analyses results

Bottling plant	Average soft drink produced (m^3/day)	Average effluent produced (m^3/day)	SEV	pH	SPL		
					COD kg/m^3	SS kg/m^3	TDS kg/m^3
A	287	700	2,44	11,2	3,70	0,92	6,45
B	221	525	2,38	11,8	2,88	nm	5,90
C	310	340	1,10	11,5	3,36	0,31	4,02
D	220	350	1,59	11,8	3,05	0,14	4,55
E	100	50	0,50	6,0	0,52	0,03	0,39
F	162	81	0,50	4,8	3,05	0,95	2,43
G	70	126	1,80	11,2	6,83	0,84	7,08
H	128	150	1,17	11,5	1,80	0,21	3,77
I	162	235	1,57	11,2	5,04	nm	5,58
J	95	39	0,41	6,3	1,90	0,01	1,29
K	47	88	1,87	7,8	0,36	0,05	0,92
L	120	180	1,50	4,0	8,45	0,44	2,07

nm - not measured

The high pH results are due to sodium hydroxide which is indicative of the use of a bottle-washing utility. The remaining lower pH's would therefore represent canning or fruit juice factories.

There is a wide range of SEV values (0,41 to 2,44) and pollution loads: - COD (0,36 to 8,45 kg/m^3), SS (0,01 to 0,95 kg/m^3) and TDS (0,39 to 6,45 kg/m^3). This is once again attributable to the varying nature of processes and product, bottle-washing and management practices. Since bottle-washing seems to be the most influential, it is more meaningful to separate the results based on these criteria. Typical final effluent SPL's are thus presented in Tables 3 and 4 for plants with or without the bottle-washing utility.

Table 3 - Typical final effluent SPL's - with bottle-washing

SEV average	COD (kg/m^3)	SS (kg/m^3)	TDS (kg/m^3)
1,72	3,80	0,48	5,34

Table 4 - Typical final effluent SPL's - no bottle-washing

SEV average	COD (kg/m^3)	SS (kg/m^3)	TDS (kg/m^3)
0,96	3,52	0,09	2,13

The difference in the SEV values clearly indicates the effluent volume contribution by the bottle-washing utilities. As would be expected, SPL's for SS and TDS are also much lower when no bottle-washing takes place.

3.4 Breakdown of pollution load

A breakdown of the SPL is only significant for plants with similar processes. Thus, Table 5 contains an SPL breakdown for those factories with bottle-washers and Table 6 for those factories without bottle-washers.

Table 5 - Breakdown of specific pollution load within a typical bottling plant - with bottle-washer

AREA	SEV	SPL COD (kg/m^3)	SS (kg/m^3)	TDS (kg/m^3)
Bottle-washing	1,00	2,20	0,28	3,10
Washdown	0,57	1,26	0,16	1,77
Utility	0,15	0,34	0,04	0,47
Totals	1,72	3,80	0,48	5,34

Table 6 - Breakdown of specific pollution load within a typical bottling plant - with no bottle-washer

AREA	SEV	SPL COD (kg/m^3)	SS (kg/m^3)	TDS (kg/m^3)
Total	0,26	0,28	0,01	0,22

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Water intake

The soft drink plants in South Africa have a range of SWI's of between 1,3 and 5,3 with a typical SWI of 2,7. This range can be attributed to the differences in processes, in packaging and in products. Considerable water saving advances have been made within the industry in recent years, the bottle-washer rinse reclamation being the most notable and this has resulted in a much improved SWI. However, due to South Africa's water scarcity, every effort should be made to further reduce water intake and a suggested target SWI is 2,3. The possible areas where water savings could be realised are:-

(a) equipment selection;
(b) equipment utilisation and modification;
(c) water reclamation and saving techniques;
(d) water monitoring and surveys;
(e) water management.

4.1.1 Equipment selection

Water usage and waste-water production should be included as part of the selection criteria when purchasing major equipment such as bottle-washers, sprays and bottling lines. Of particular importance is the water usage efficiency of bottle-washers as they can be responsible for a large percentage of the water intake. Automatic shut-off valves and high-pressure, low-volume jets for hose pipes have also proved to be effective in helping to reduce water intake. Attention should also be paid to future developments such as varying heat transfer systems, e.g. oil as a substitute for steam and also radiators as an alternative to the traditional cooling towers.

4.1.2 Equipment utilisation and modification

The effective utilisation of equipment can greatly reduce water intake:

(a) **Bottle-washer** - Water usage, as well as effective rinsing is influenced by using the optimum jet pressures and the correct spray nozzles. The use of pulsating jets should also be investigated. Older bottle-washers should be modified to ensure that bottle spraying is discontinued once the machine is shut off.

(b) **Water treatment plants** - An over-capacity water treatment plant can often result in large water wastage due to the backwashing of unnecessary sand and carbon filters.

(c) **Hose pipes** - The utilisation of hose pipes for floor washing should be minimised and greater use made of squeegees and hard brooms.

(d) **Equipment modification** - Water-using equipment can be modified to include recycling of water. Water used as mechanical seals, e.g. compressors and vacuum pumps, can often be collected and reused.

4.1.3 Water reclamation and saving techniques[2]

(a) **Bottle-washer rinse reclamation** - There are two reclamation systems which have been successfully developed since 1976 and are presently in operation in a large number of bottling plants in South Africa. They are the ion exchange and CO_2 neutralisation systems. The ion exchange process is capable of reclaiming up to 90% and the CO_2 system up to 75% of the final rinse water.

Although the ion exchange system is capable of handling a larger volume of water, its cost and difficulty of operation as well as its contribution of salts to the effluent and the ready availability of CO_2, has resulted in the CO_2 neutralisation system becoming the more popular.

Since an average sized bottle-washer uses approximately 25 m^3 of rinse water per hour, it is highly recommended that one of the bottle-washer rinse reclamation systems be implemented in those plants in which a reclamation system does not exist.

(b) **Filter backwash recovery** - A large percentage of filter backwash water can be recovered or cascaded (see 4.1.3 (e)) for use as service water. Once the initial high solid content dirty water has gone to drain, the remaining water used in the backwashing operation can be reclaimed into a recovery tank and then either reintroduced into the product water treatment system, or used for a service requiring a lower quality water e.g. floor washing.

(c) **Can/NRB rinse water** - This rinse water can be collected and reintroduced into the water treatment system or cascaded to areas of lower water quality requirements.

(d) **Counter-current flow** - A good example of counter-current flow is found in the bottle-washing operation (Section 2.2.5), where there is an optimal utilisation of water in terms of its reuse and heat exchange capacity. This type of technique could be implemented for the truck washing station where dirty water could be used as a pre-wash.

(e) **Cascading** - Cascading is the term describing the technique of reusing the water after a process requiring high quality in another process that could utilise a lower quality water. An example of this would be the used NRB rinse water being stored for service water such as truck, crate or floor washing.

It should be noted that any reduction in water intake will increase the effluent concentration due to the reduced dilution effect. It is therefore important that reduction of water intake should be implemented simultaneously with measures aimed at reducing the pollution loads.

4.1.4 Water monitoring and surveys

Accurate water meters (calibrated at least once every two years), selectively installed in water-intensive areas, and which are regularly monitored, will identify and help isolate those areas having an unneccessarily high water consumption. They will also supply information as to the effectiveness of any future water-saving techniques installed in the plant, as well as to instill an awareness of the need for water conservation in the relevant staff.

Regular, simple water surveys of the different water-using areas could be devised to help in the monitoring of water consumption, as well as to supply information as to the state of equipment e.g. taps, pipes and valves.

4.1.5 Implementing a system

It is imperative that the person in the plant responsible for water and effluent-related matters implements a system to follow up on the information collected during water surveys.

4.2 Effluent[3;4;5;6]

The quality and quantity of effluent can vary enormously depending on the size and nature of the plant and the management practices implemented. It is thus even more difficult to set SPL targets than for SWI but the survey results indicate that an SPL of 3,5 kg COD/m^3 of soft drink would be reasonable.

Table 7 shows the common sources of contaminants from typical bottling/ canning plants.

Table 7 - Sources of contaminants in a typical soft drink plant

Area	Contribution
Water plant treatment	Inorganics - water treatment chemicals, solids
Syrup room	Cleansing chemicals, sucrose, flavourants
Bottle-washer	Caustic and other cleansing chemicals, solids
Bottling/canning	Solids, sucrose, flavourants

To assist in the control and managing of the pollution load it is recommended that the flow volumes in the effluent stream be accurately monitored. Open channel flow can be accurately metered by using flumes or weir plates.

Having installed a flume or weir, only measurement of water depth is needed to calculate the flow.

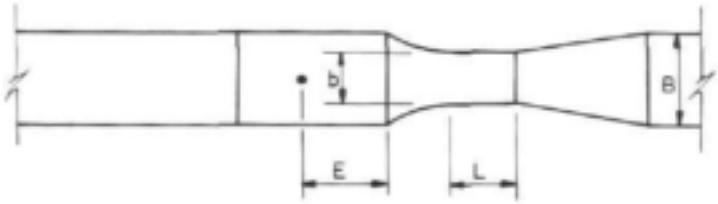
For a flume, if
Q = flow in m^3/s
b = restriction width in m
C_v = velocity factor
C_e = outlet coefficient depending on friction losses
h = backup water height in m
g = 9,81 m^2/s

then

$$Q = \left(\frac{2}{3}\right)^{1,5} g^{0,5} C_v C_e bh^{1,5}$$

Further details on flume calculations can be obtained from British Standard BS 3680 : part 4C : 1981 entitled "Methods of Measurement of Liquid Flow in Open Channels". This document can be purchased from the South African Bureau of Standards. A similar document dealing with weirs is also available (BS 3680 : part 4A : 1981).

Figure 5 Plan view of typical flume



PLAN

B = downstream channel width in m
E = distance of measuring point upstream of commencement of restriction
L = length of restriction in m

4.2.1 Reducing pollution load

The pollution load is determined by volume multiplied by concentration. Thus, although a reduced water intake will reflect a reduced volume of effluent output, it does not necessarily reduce the pollution load due to the subsequent increased concentration.

The major areas in which contamination can effectively be reduced are discussed below:-

(a) **Minimisation of product loss** - Losses generally occur during product change-overs. Remnant syrup should be collected and kept for later usage. The number of product change-overs should be minimised through careful forward planning. Bottle and can handling equipment must be carefully adjusted to minimise loss of product during transfers on the conveyors. Filling heights, especially in canning plants, should be accurately monitored to reduce beverage spillage.

(b) **Minimisation of chemical usage** - One of the main contaminants of effluent in the soft drink industry is caustic soda, mainly through its use in bottle-washers. Caustic soda usage can be reduced by using a lower strength, higher temperature combination. Techniques are available for the reclamation of caustic soda from bottle-washing effluent. Carry-over of caustic soda into the rinse section of the bottle-washer should be minimised by ensuring sufficient drip times. Any used caustic soda solution should be neutralised (Section 4.3.3) before discharge to the final effluent drain. Cleaning agents can be used at lower dilution and in some cases reclamation and recycle is possible e.g. CIP.

(c) **Solids reduction** - The selection of returnable bottles should be restricted to those having the durable type of label (applied colour label or ACL). This would prevent fibre from the paper labels and contaminants from the adhesive entering the effluent stream.

4.3 Effluent treatment

Apart from the increasing cost-effectiveness, industry should feel some moral obligation to treat their effluent. Most importantly it will help save water but also it will serve to improve general public relations. The degree of effluent treatment can range from the most basic of screening techniques through to a complete treatment system producing waste water complying with general standard requirements suitable for discharge into the natural watercourses.

4.3.1 Solids removal

Prior to balancing or discharge, soft drink effluent should undergo solids removal to prevent labels, can and bottle lids and other solids from entering the effluent stream. This can be done by using the simple manually cleaned screens or the more sophisticated rotary, vibrating or static wedgewire types.

4.3.2 Balancing or segregation[7]

Balancing is the storage and mixing of effluent over a chosen period to smooth out the variances in both volumetric discharge and pollutant strength. These variances are particularly prevalent in the soft drink industry due to sudden high concentrations of syrup or detergents being discharged. Balancing facilitates a controlled discharge of an effluent with a more or less constant pollution load. Balancing is highly recommended even if the effluent is to be discharged to the municipality, since a balanced effluent is much easier to treat.

An alternative to balancing is segregation which is the separating of the different effluent flows into those that require treatment and those that do not. This may allow for much smaller treatment works due to reduced volumes.

4.3.3 pH control

The intermittent or continuous dumping of caustic can cause extremely high pH and inorganic levels. Effluents of this nature should be neutralised to bring the pH within acceptable limits before discharge into the final effluent sewer. Neutralisation can be carried out, either as a batch or as a continuous process, using acid addition (hydrochloric or sulphuric) or CO_2. Carbon dioxide is the most convenient reagent for neutralisation in the soft drink industry since CO_2 is cheap and readily available on site. Approximately 1,1 kg CO_2 is required to neutralise 1,0 kg sodium hydroxide producing sodium bicarbonate. Neutralisation plants are available as propriety units and incorporate loop reactors. Gaseous neutralisation performs more economically if the gas is diffused in fine bubbles.

4.3.4 Biological treatment

The majority of soft drink manufacturing plants discharge their waste water to municipal systems. However, with ever increasing effluent tariffs, many plants may consider installing on-site treatment facilities. The waste water can be treated by conventional biological processes provided the COD : nitrogen : phosphorus ratio is acceptable.

The characteristics of present-day bottling plant waste water make it amenable to anaerobic treatment. Anaerobic treatment requires less nitrogen and phosphorous supplementation (both of which are deficient in bottling wastes), than the more popular aerobic treatment system. A high-rate anaerobic system has been developed and is now available in South Africa. This system requires a lower retention time and occupies much less space than the traditional anaerobic or aerobic treatment plants. This is particularly relevant since space is often a limiting factor as soft drink plants tend to be located in or near urban areas.

Future developments are likely to include the use of reverse osmosis and ultrafiltration techniques to achieve total water reclamation for a plant. Complete caustic recovery is also feasible using these techniques.

4.3.5 Emergency process liquor discharge/bulk dumping of process liquors

In the event of the emergency discharge of process liquors e.g. syrups or the regular dumping of caustic solutions, the local authority should be notified in advance. It is recommended that caustic is neutralised by CO_2 rather than acids in the event of this type of discharge.

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