Ministry of Foreign Affairs

Sector Scan; the potential South African demand for industrial water re-use solutions

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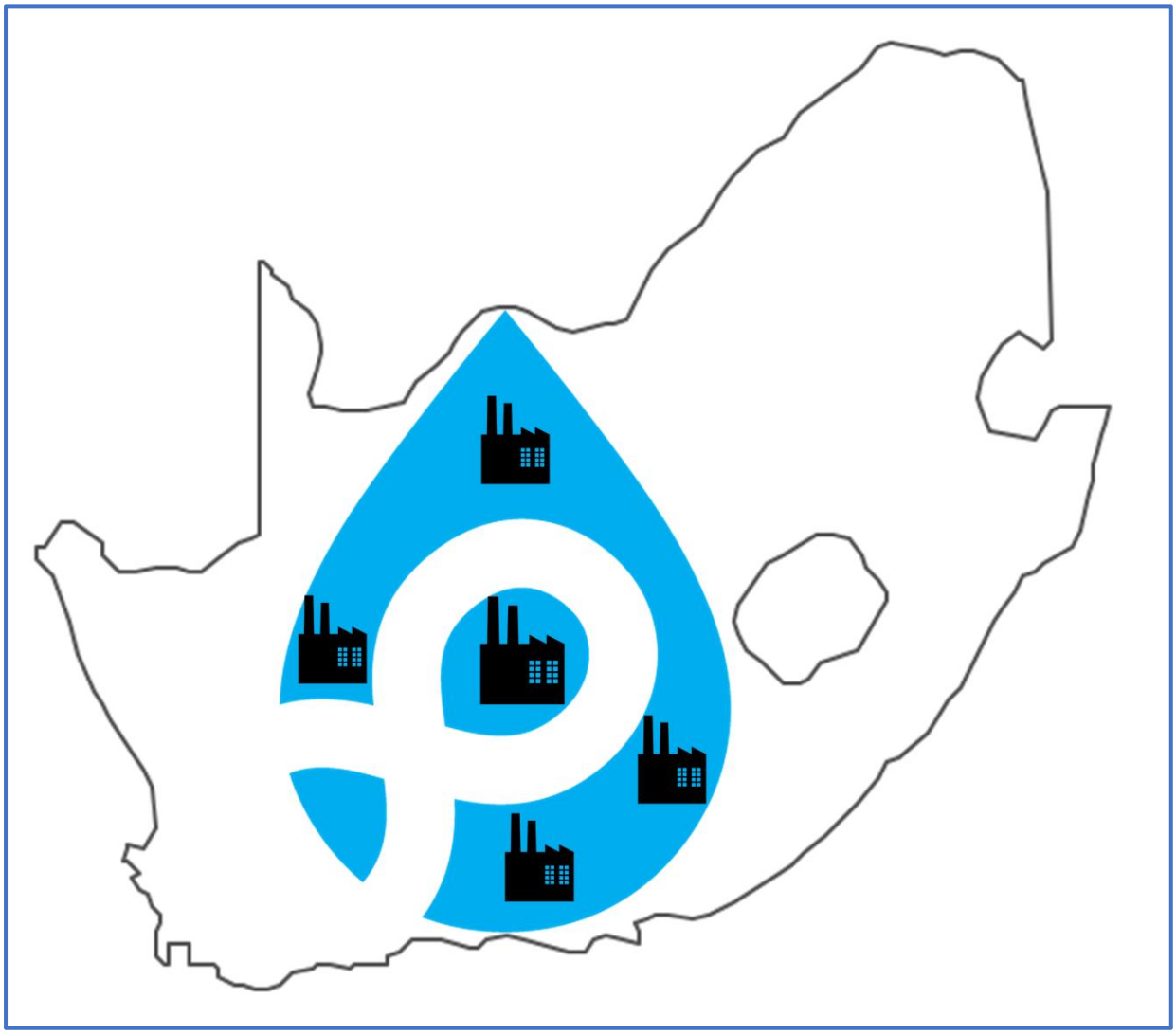

Sector Scan; the potential South African demand for industrial water re-use solutions

Project: Matching Dutch Industrial Water Re-Use Solutions with Challenges and Opportunities in South Africa

June 2018, commissioned by the Embassy of the Kingdom of the Netherlands in South Africa

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SYNOPSIS: This is a quickscan of readily available information on water re-use practises in South Africa's industries during the period of May 2018.		
COPYRIGHT: Partners for Water, Embassy of the Kingdom of the Netherlands in Pretoria, South Africa, and Netherlands Water Partnership. For questions please contact Maaike Feltmann (NWP) m.feltmann@nwp.nl		

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1. Introduction

This sector scan is in preparation of match making Dutch industrial water re-use solutions with challenges and opportunities in South Africa. The purpose of this initial sector scan is to have a short document that introduces the South African industry to the Dutch interested parties, and directly to the match making consultant on the Dutch side (Mr Wim Maaskant).

This scan is the first step in the process to come to potential matches between South African and Dutch organisations. This is followed by two workshops in June 2018, one at the WISA2018 conference on 26 June 2018 and one at the Netherlands Embassy in Pretoria on 28 June 2018, both titled 'Co-creating water re-use for industry in South Africa'. These workshops investigate South African challenges around implementation of water re-use in industry and potential solutions to those challenges. With the outcomes of these workshops, the match making consultant on the Dutch side will investigate potential technologies in the Netherlands that match the demands for water re-use solutions. In case of sufficient interest on the South African and Dutch side, these workshops will be followed by a trade mission of Dutch companies to South Africa in October / November 2018.

The main goal in the sector scan stage of the match making is to identify South African companies that might be interested in the Dutch solutions. However, these established contacts are not part of this document as they might contain competition sensitive information. Additional information can be requested from The Netherlands Water Partnership, programme manager Southern Africa, Maaike Feltmann < m.feltmann@nwp.nl >.

2. South African context

2.1 Organisation within companies

In most companies we contacted, for wastewater re-use opportunities we were referred to the Sustainability Manager. At individual plants often an Environmental Health and Safety officer was in charge. Very often these persons were not specifically specialized in water management, as their titles included more responsibilities. Some companies, like Pioneer Foods, explicitly have the goal of water re-use published on their website (http://www.pioneerfoods.co.za/sustainability/our-environment/).

2.2 Drivers for water re-use in industry

In GreenCape's market intelligence report on water focusing on the Western Cape (GreenCape, 2018), the main driver mentioned for the implementation of water re-use systems in the industrial sector is the risk of insufficient water supply, due to increasing water scarcity and water restrictions.

South Africa is generally a water scarce country, and as such water re-use has been high on the government agenda through the Department of Water and Sanitation (DWS) National Water Resources Strategy II (NWRS II, DWS, 2013). Waste water re-use has the potential to reduce demand on freshwater resources and improve water supply to industry. With recent droughts having resulted in water restrictions in most of the major industrial cities, and with climate change projections aggravating the risk of future droughts, water availability in South Africa is a major concern for policy makers and industry alike. Thus, it has become increasingly interesting for industry to consider water re-use as a source, taking into consideration the cost of traditional supply sources and more stringent effluent disposal penalties.

Other drivers for water re-use mentioned by GreenCape are: municipal water quality discharge regulations, corporate social responsibility, and improved reliability of wastewater treatment systems. Our interviews with industry in Gauteng indicate that risk of failing water supply is also the biggest driver there.

The Department of Water and Sanitation as a regulator is targeting the reduction of high impact pollutants. Their perspective is shown in Figure 1, which gives an estimation by the Department of Water and Sanitation for the impacts of different pollutants on the environment and the knowledge levels in the country.

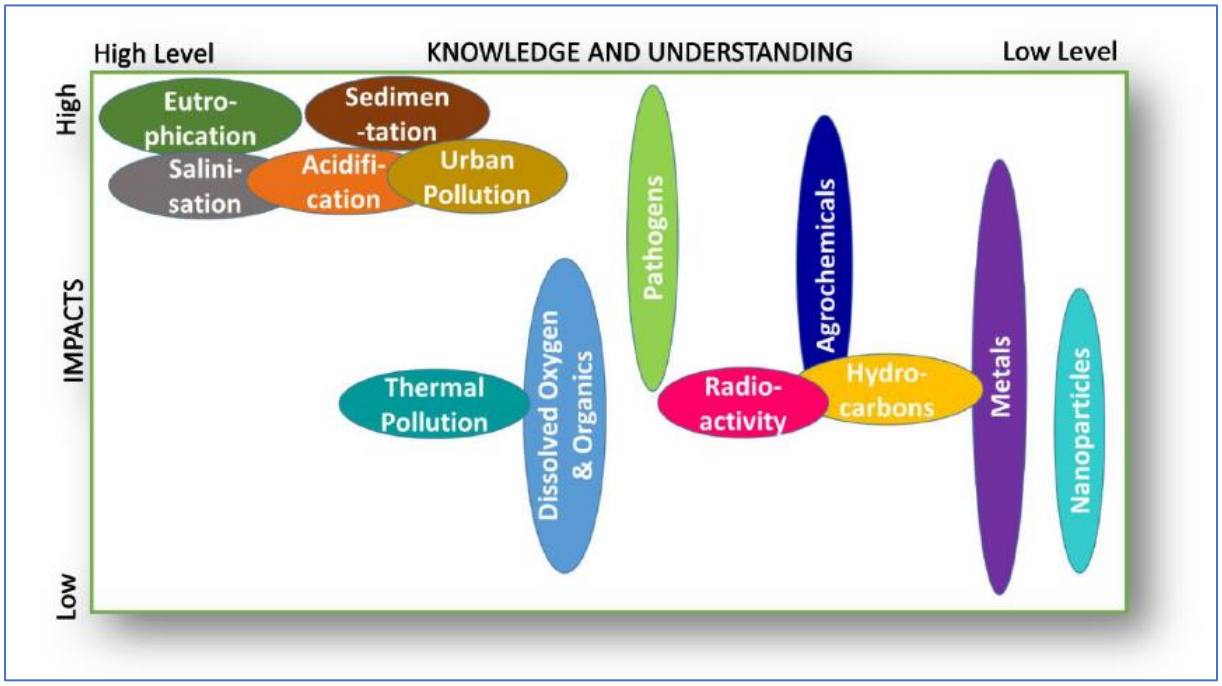

Figure 1 Mapping of water quality issues against impacts and knowledge and understanding, by Department of Water and Sanitation South Africa (2016, Report No. 1.2.3: A Review of Water Quality Management Instruments for South Africa. Inaugural Report)

2.3 Barriers for water re-use in industry

Barriers mentioned in GreenCapes market intelligence report (GreenCape, 2018) are high capital costs, brine disposal challenges, land availability, public perception on water re-use products (in particular in food industry) and also a lack of knowledge and awareness of technologies.

From our literature review we also concluded that in the case where water efficiency practices had not yet been sufficiently conducted, then water re-use would not be on the agenda. Water efficiency measures are often more cost effective and will decrease the risk of water quality standards not being met, therefore industry would give them more priority. The companies who are really interested in water re-use, in our experience, are front runners in water management. They are often international companies, with a good knowledge of suppliers worldwide.

We also concluded that the costs and reliability of supply of electricity might be a barrier as well, for energy intensive processes to treat wastewater. In a company which uses processes to remove salts, this was specifically mentioned. The water-energy nexus is here a point in case. Price hikes and electricity load shedding in recent years may play a role here.

Additionally, companies see opportunities for effluent re-use at neighbouring companies, who will possibly need fit-for-purpose water quality that is less stringent on the processes than water re-use at their own plants. Legal restrictions of becoming a water services provider in the sense of the Water Services Act (1997) are mentioned as a barrier. While precedents are available in South Africa (e.g. Witbank, Coega) to show that it is possible, the local municipality will have to take an active role and will have to accept the lost revenue for themselves, in case the water re-use decreases the demand for water supplied by the municipality.

In the companies we consulted, brine disposal challenges were confirmed in the agro-food processing factory which already uses Reverse Osmosis and would like to implement it on other plants.

2.4 Government policy interventions

The National Water Resources Strategy II (DWS, 2013) has a separate Annex D which is called the National Strategy for Water Re-Use. The ambition was expressed to improve on water re-use, but the actions mainly refer to further research and further actions to stimulate water re-use such as development of guidelines for water re-use, review of the laws and regulations to assess the need for amendment to facilitate re-use, exploring the use of new technologies. Municipalities were obliged to conduct feasibility studies of water re-use options in all water-scarce areas, but this focused mainly on water re-use of their own wastewater treatment plants. Such investigations were in 2013 planned to be finalised in 2018 for eThekwini (treated effluent from eThekwini and KwaMashu), Nelson Mandela Bay, Rustenburg, Mangaung, Buffalo City, George-Mossel Bay, and Mbombela-Bushbuckridge.

Our impression is that the efforts of national and local government on water re-use for industry, mainly focus on use of effluent of municipal wastewater treatment plants in industrial processes. Water re-use by industry itself was and is left to the industries themselves.

The Department of Water and Sanitation has been developing for different towns and areas what is called 'Reconciliation Strategies' (reconciling water demand and water supply), which are more specific in targets of water re-use and water efficiency per area. The NWRSII mentions that for water re-use to be considered in these Reconciliation Strategies, first the reliability of the wastewater treatment plants in meeting effluent standards had to be attained. In general, the commitment of industries to Reconciliation Strategies is for most areas still to be confirmed, although they are engaged in the processes to form Reconciliation Strategies and reflect on their updates and the implementation.

2.5 Legal obligations

All industries that discharge on surface water or groundwater, will have to apply for a Water Use License, which will receive individual water quality requirements and volume requirements dependent on the receiving water body.

When applying for a water use license for effluent discharge or for use of water resources, an integrated water and waste water management plan will have to be submitted for evaluation (Government Gazette, No 40713, 2017). While not explicit in the regulations, water conservation and demand management, including water re-use, will play a role.

Many industries release their effluent into the municipal sewer. In this case, they would have to comply with the water quality standards of the local by-laws, which are quite different per municipality, and often out dated.

As mentioned in section 2.3, when water re-use involves two different companies, the Water Services Act comes into play.

2.6 Facilitators

There are different sector organisations that are supportive of sustainable water use by industries in South Africa and therefore of water re-use:

- **National Business Initiative (NBI),** is "a voluntary coalition of South African and multinational companies, working towards sustainable growth and development in South Africa and the shaping of a sustainable future through responsible business action, thereby demonstrating business action for sustainable growth". They are facilitating companies to also comply with CPD Water sustainability reporting. The CPD reports are available. The main members are larger companies, who are registered on a stock exchange and therefore have to comply with certain reporting in their annual reports.
- **Strategic Water Partners Network South Africa (SWPN-SA),** is a collaboration between government and private parties. The SWPN-SA has working groups that exchange ideas and are developing projects. The SWPN-SA has sent out a news flash for this match making project, which resulted in several reactions. Programme Manager Nick Tandi will participate in the WISA workshop.
- **Water Institute South Africa (WISA)**, which is a membership based organisation, of which most water sector professionals in South Africa are a member. They have a water-re-use group, chaired by Chris Schwartz, who will participate in the WISA workshop.
- **GreenCape**, is a non- profit organisation that supports businesses and investors in the green economy to remove barriers to establishment and growth. Their main focus is on the Western Cape. In their market intelligence report on water (GreenCape, 2018), they claim that the main driver for the implementation of water re-use systems in the industrial sector is the risk of insufficient water supply, due to increasing water scarcity and water restrictions. Therefore, in this report the water supply of the industries is also explained as a driver for water re-use. Other drivers mentioned are: municipal water quality discharge regulations, corporate social responsibility, and improved reliability of wastewater treatment systems. Barriers mentioned are high capital costs, brine disposal challenges, land availability, public perception and also a lack of knowledge and awareness of technologies
- **Water Research Commission**, which funds research in the water sector and also has a research group on 'Water Use and Waste Management' and therefore many contacts in the sector. The National Surveys (NatSurv) they did in water management in industry, are used for the literature study in this report.

2.7 Investors in joint water-re-use facilities

Development Bank Southern Africa is orientating itself in how it can get involved in financing industrial wastewater re-use facilities that services different companies in each other's vicinity. They have been invited to the upcoming workshops.

A private initiative approached for the match making, has also indicated that it is orientating itself in this market of investing in joint waste water treatment facilities for industries and providing the treated effluent back as re-use water.

3. Recommendations for (Dutch) solution providers in entering the South African industrial water re-use market

From the contacts made with different companies, the reactions on preliminary invites to the workshops and the literature study following in the next chapter, the following recommendations are derived for the Dutch solution providers:

- Different types of industry produce different wastewater and therefore require different treatment processes. Process water recycling and cascading water use is already applied in many industries, where it makes either financial sense or where there are corporate policies in place which encourage these practises. The demands of the identified South African companies might not fit the treatment technology offered by the Dutch companies, such that further matchmaking and follow up before the trade mission in October 2018 is required.
- Industry umbrella bodies also play a significant role in advancing new technologies and solutions to its member companies. We consider these a useful entry point for introducing wastewater solutions.
- The Strategic Water Partners Network (SWPN), GreenCape and the WISA water re-use group are also a useful entry to the market. The greater number of response to workshop invitations actually came via a mail gone out through the SWPN. The membership already indicates interest in improving water management, and there is more willingness in member companies to embrace new technologies.
- There are also many other companies in South Africa, whose impact on the environment is large and who might not always comply with regulations on effluent quality standards and amounts. The sector scan showed that some industries were not being inspected by municipal authorities and some were actually operating without trade effluent licenses. This reduces the companies' chances to embrace water efficiency and wastewater management strategies if there is no incentive or punitive measures associated with such actions. The majority of companies would therefore need a build-up of trust and probably signing of non-disclosure agreements for them to share information on their real demands for wastewater treatment and re-use.
- Water re-use as a means to gain water security is gaining momentum with companies, due to the recent droughts and the still increasing demands, although our experience – in line with international similar experiences - is that that might be temporary attention (so called policy window), without yet budgets for real investments. Gauteng has had water restrictions two seasons back, and the contacts approached to organize the workshop in Gauteng, seem to at least be aware of scarcity of water and the risk of droughts.
- So far, for legal and institutional reasons (as explained in Chapter 2) water re-use solutions between different companies have hardly been implemented. Such initiatives, will treat to fit-for-purpose water quality levels for neighbouring companies, to minimize costs of treatment. There are players on the South African market (DBSA and a private company) that are orientating themselves in how this joint water re-use can be opened up. It makes sense to be aware of such initiatives for solution providers in an early stage.

4. Insights in different industrial subsectors

3.1 Introduction

Different types of industry produce different wastewater and require therefore different treatment processes. Also, competition in the market and/or their location in the country, will affect how advanced they are in implementing sustainability measures for water. All these differences influence the demand for (Dutch) water re-use solutions.

For the companies interested in water re-use solutions provision to South Africa, a more detailed look at different sectors within South Africa, can give an impression of these differences. Therefore this chapter is added, starting with an overview in Table 1 of our conclusions for the sectors that were indicated as being of specific interest to the Dutch solution providers. This table is followed by the literature review for the specific objective of water re-use, of the National Surveys on water management in industry (NatSurv) that the Water Research Commission commissioned, with a short introduction on the background of the NatSurv studies.

The sections on the specific sub-sectors for which a National Survey on water management was done, can also assist solution providers for other sectors to get an impression of the state of water management in industry in South Africa.

Table 1 Overview of industrial sectors assumed to be preferred by Dutch solution providers and main information gathered, before the workshops

Industry	Contaminants	Further information relevant for match making on wastewater re-use opportunities
AgroChemicals		No NatSurv report available. Interest shown by an agrichemical company who may participate in the workshop in Gauteng.
Food processing		No overall conclusions, see subsectors below for which NatSurve was available. Pioneer Foods has water re-use targets published on their website. Other companies have been approached, with mixed reactions.
Soft drinks	COD, TSS,	Generally minimal to meet by-laws for effluent discharge to municipal wastewater system. Mainly pH adjustment. Still many opportunities for water efficiency measures, which will possibly be prioritized before water re-use. But different options for re-use: washing of floors, trucks, on site use. Water re-use to the extent of washing bottles would require RO but is considered (in WRC report) too costly and too risky in terms of health risk perceptions. Big multinational companies. Coca Cola, Unilever, Nestle are already active on water stewardship.
Edible oil	pH, COD, fats, oils and grease, TSS	Recovering heat condensates and blow down wastewater. Locations of edible oils companies: mainly Western Cape (mainly olive oil) and Gauteng (Ekurhuleni).
Sorghum brewing	BOD, COD, TSS, TDS	Declining industry, cost sensitive, therefore minimal treatment. Re-use of final rinse water in the pre rinse stages and re9use of the keg washing water, is an option for this subsector.
Brewing		No NatSurv report available. AB-Inbev has concrete plans to increase water re-use in several plants. Interview report provided to Netherlands Water Partnership.
Red meat	COD	NatSurv report available. Advanced treatment processes for large abattoirs, minimal for smaller onesGreater potential for water use efficiency than there is for water re-use. Water re-use possibilities are mentioned for the stormwater which can be collected and be issued for irrigation.
Metal finishing		Gauteng Automotive Industry Development Centre will participate in the Gauteng workshop and indicates that there is need to re-use wastewater particular as the industry mostly relies on harvested rainwater. The major challenge is storing this water in a useable state.
Iron and steel	Heavy metals, pH	NatSurv report available. Wastewater re-use currently being practised across the industry, including importation of treated wastewater for re-use in process. Advanced technologies applied
Electronics		No NatSurv report available. No positive reactions on companies approached; denied wastewater.
Petrochemicals		SASOL has been interviewed. Main interests are water re-use from cooling towers and purification of salts. Big water user, but advanced in its approach and with a very knowledgeable procurement section.

3.2 Water Research Commission National Surveys for different industries

The Water Research Commission (WRC) initiated a program for industry National Surveys (Natsurv) per industrial sector, and has been implementing these surveys studies since 1984. The NatSurv project was aimed at identifying priority industries which consume large volumes of clean water and discharge highly polluted wastewater. The period 1987-1993 saw the publication of reports for various industries. We consider these reports too outdated for the purpose of matchmaking with Dutch Industries. But they are still available through WRC for background information on South African industries. In 2013, the National Surveys got a new kick start, through revising the original survey and updating findings from those first surveys. The production of the second editions of the National Surveys has begun and is still continuing. The reports give a good outlook on the operations of industries in South Africa with respect to water usage and wastewater treatment and thus their importance in this study. The key focus of the WRC-NatSurv studies was to review industries according to:

1. Water usage
2. Effluent volumes
3. Energy consumption rates
4. Best practices in the management of water and effluent
5. National and local legislation that regulates the particular industry operations

Table 2 NatSurv reports on water management in South African industries

Sector	1st Edition report (before 2013)	2nd Edition Reports (after 2013)
Agrochemicals	Not available	
Food processing		
Soft Drinks	1987	2015
Edible oils	1989	2016
Malt- Brewing	1987	2016
Dairy	1989	No update
Sorghum Malt and Beer	1989	2016
Red meat	1988	2016
Poultry	1989	2017
Sugar	1990	No update
Fruit and vegetable	1987	No update
Pelagic fish		No update
Metal finishing	1987	2016
Electronics	Not available	No update
Petrochemicals		
Oil Refining	2005	No update

Sector	1st Edition report (before 2013)	2nd Edition Reports (after 2013)
Other		
Power Generation	2005	No update
Laundry	1989	2016
Tanning and Leather finishing	1989	2017
Pulp and paper	1990	2016
Iron and steel	Not available	2016
Textile	1993	2017

As part of providing a brief overview into each of these industrial sectors, each of them will be discussed to find out the major challenges facing the industry, the key contaminants found in wastewater produced and incentives for water re-use that are currently in place for the industry. The legal framework that governs the operations of companies within each of the sectors is critical in determining their level of legal obligation and will thus be taken into account during this sector scan.

3.3 Soft Drink Industry

3.3.1 Sector and water management

The WRC-study of the soft drink industry was conducted in 2015 by the Pollution Research Group of the University of KwaZulu Natal (PRG-UKZN). The review of this industry takes into account production of carbonated soft drinks, fruit juices, bottled water, energy drinks. Seven companies were interviewed, but in the details the maximum plants studied is nine, so probably some companies had more than one plant.

There has been significant changes in the industry since the 1987 survey, with the industry becoming more water efficient and significantly reducing the average specific water intake from 2.7 litres of water per litre of product to 1.6 litres water per litre of product (PRG-UKZN, 2015). The bigger players in this industry include Coca Cola, the former SAB Miller which has since become a subsidiary of Anheuser-Busch InBev since 2016, Tiger Brands, Pioneer Foods and Unilever among others (Wesgro, 2016). There are different products classifies as soft drinks, including non-carbonated drinks and including juices. This already gives a variation within the soft drinks industry with regards to water intake and effluent composition.

3.3.2 Current wastewater management practices

Most of the companies that formed part of the soft drink industry study use the normal municipal wastewater treatment system and therefore water is treated on site to specific municipal standards, if at all necessary. Much of the effluent consists of settleable solids from fruit processing and is concentrated with sugars. The majority of sites carried out no treatment, or only pH adjustment. This is not particular for South Africa, as a similar situation is described for waste water treatment by the

soft drinks companies in the UK. Although it was mentioned as a general statement that treatment was limited, 3 out of 7 companies reported to have sand filters for backwash water, and 4 had carbon filters.

The enforcement of and monitoring of the industry compliance to regulations is weak and industrial operators are not quite aware of the monitoring process (PRG-UKZN, 2015).

Stormwater management is also not largely practised in the industry with minimal measures in place to abate stormwater pollution from the processing plants.

3.3.3 Potential for wastewater re-use

Re-use considerations

A major use in the industry is the cleaning of floors as well as water re-use in the building facilities (air conditioning, toilet flushing etc.), and irrigation of grounds. One fruit juice company surveyed was supplying waste water effluent for irrigation purposes. Rinse water / wash water, as effluent of a treatment plant, could also be used for bottle rinsing and bottling, but it is mentioned that this would require reverse osmosis treatment, which is considered too costly and would be too much associated with wastewater to be acceptable for marketing. However, 1 out of the 9 plants surveyed had a Reverse Osmosis system. Wastewater from bottle rinsing can be used in crate washing. Re-using water for cooling purposes is also mentioned, as well as using steam generators condensate for washing of trucks, with the water being directed back to the boiler. The use for cooling purposes was not implemented yet by the 9 plants surveyed, but 4 had plans.

Water supply concerns related to water re-use opportunities

Water supply is of course important, and most industries use municipal water supply as their source water. The main parameters of concern when using municipal water are mentioned as pH and Trihalomethanes. The industrial effluent is high in Total Suspended Solids and Chemical Oxygen Demand. The NatSurv report recommends several water saving options, that might have a higher priority than implementing water re-use: 'Clean In Place' technologies to remove product soil from pipes and equipment, as well as other bottle rinsing and washing techniques, sealing of pumps, improving operation and maintenance of steam systems.

3.4 Edible oils industry

3.4.1 Sector and water management

The second revision of the national survey for the edible oil industry was carried out by P.J. Welz, M le Roes and C. Swart in 2017[1]. Their study considered oil extracted from fruit and seeds which are liquid at standard temperature and pressure. The major products being sunflower oil, olive oil and canola oil. The trend has changed from the first edition of the NatSurv report which showed more of groundnuts and sunflower seed oil. However, currently there is growth in the canola oil industry due to its favourable nutritional profile and cost effectiveness, as it is highly extractable. As a result, the production of canola oil has increased by over 40% in the 2012/2013 to 2014/2015 period. Almost all

[1] WRC report number TT702/16

the canola is currently grown in the Western Cape region. The olive oil industry has also seen remarkable growth, however only 10% of the current local olive oil processors account for 90% of the production with the number of players set to increase. Olive oil processing is mostly practised in the Western Cape where the climate is favourable, although over half of the 17 oil processing plants in the country are located in the Gauteng province. In the contrary, cotton seed oil has seen a marked decline over the years as the textile industry in South Africa has gone into a recession.

The major processes in the production of edible oils can be divided into;

1. Pre-treatment
2. Pressing
3. Extraction
4. Refining/purification

The extraction and refining phases use a lot of water and subsequently large volumes of wastewater are produced. The oil processing industry, relies on seeds for their input Seed growing is seasonal but of the harvest is stored so that production occurs all year round.

Unfortunately, there was a general lack of participation by local industries in this study and therefore there was limited industry specific data on water use and wastewater generation.

3.4.2 Current waste water management practices

Of the seed oil industries that participated in the study, all were using potable municipal water. Significant volumes of water are used in the refining and extraction phases of edible oil processing. Cooling water is recycled while the wastewater from the extraction phase in disposed. The choice of process technologies has a significant bearing on the volume of water used; Continuous or semi-continuous versus batch processing can double the water requirements.

Fruit oil processors where water is mostly used for fruit washing cleaning floors, the main water sources were borehole and harvested rain water. The water use practices of fruit oil processors suggest low water usage. Wastewater parameters of concern in this sector are COD, grease, oil and fats, TSS and pH. Phosphorus and nitrates may also be found in the effluent if phosphoric acid and sulphuric are used during processing.

3.4.3 Potential for wastewater re-use

Water supply concerns related to water re-use opportunities

There are no recorded concerns with regards to municipal water supply or groundwater supply although the report mentions the projected increase in the price of municipal water which could have a negative impact on the industry.

Re-use considerations

The report highlights that there are opportunities for water re-use, for example in recovering heat condensates and blow down wastewater which can also be re-used to moisten coal ash or be treated via reverse osmosis to be re-used as process water. Although the study could not determine the wastewater treatment efficiency, the quality of effluent from historical data suggested that there was

a problem with polluted effluent from the edible oil industry. The fruit oil processors (olive oil) were using wash water and process water for garden irrigation and composting.

3.5 Sorghum brewing industry

3.5.1 Sector and water management

The second revision for the national survey of the sorghum brewing industry was carried out by N. Musee in 2016 (Musee, 2017). There were notable changes since the first edition in 2003, which include a decline in the demand for the product sorghum beer. This resulted in a significant decrease in production output. United National Breweries (http://www.unbreweries.co.za) is currently the dominant industrial player with almost 100% market share. The result has been the decrease from 12 malting plants in 2003 to 4 in 2016 under the management of United Breweries. These four plants are in Isithebe, Potchefstroom, Pretoria-West and Congella.

However, the industry has seen positive changes in its operational processes through the use of modern technologies and adoption of industry best practises. This has resulted in the significant improvement of wastewater and water management from the results of the first survey, thanks to water use efficiency and wastewater management interventions. The industry is completely reliant on municipal water supply which has largely been meeting the required minimum standards for beer production. Where the municipal water falls short, additional treatment processes are effected. The production processes consist of the malting and brewing stages. For 1 litre of sorghum beer produced 3.54 litre of water is used in the malting process, this is the specific water intake (SWI). The average SWI for the brewing process is 7.85 litre per every 1 kg of malt produced. The SWI varied widely across the 4 breweries showing possible inconsistences in water management practices.

3.5.2 Current wastewater management practices

The report showed that the effluent quality in the sorghum beer production was process dependent and variable. The main water quality parameters of concern in the effluent are Biological Oxygen Demand, Chemical Oxygen Demand (COD), Suspended Solids (SS), and Total Dissolved Solids (TDS). It was estimated that for every 1000 litre of sorghum beer produced, 2254 litre of wastewater was produced resulting in a Specific Effluent Volume (SEV) of 2.26 l/l. The monitoring of effluent quality from the breweries was inconsistent and those results that were captured showed that the effluent exceeded the set limit particularly for suspended solids and COD. This suggested that the wastewater treatment procedures used were not adequate. In the malting process for every kg of malt produced, 3.55 l of effluent was produced.

The report did not further show how the discharge of this highly polluted wastewater was impacting industry in terms of discharge fees. There was no mention of the current wastewater treatment technologies for the industry, which is an area that can be explored further. However, the cost effectiveness of the solution has to be strongly considered as the industry already faces challenges in the market.

3.5.3 Potential for wastewater re-use

Re-use considerations

The study suggests that there has been limited research into this industry regarding general water management practices and that the industry could benefit if such considerations were to be taken into account. However, the stringent standards of the food industry have to be taken into account when considering re-use solutions. Specific recommendations for the industry was for re-use of final rinse water in the pre-rinse stage. And the re-use of keg washing water to reduce water use and cleaning chemicals.

Water supply concerns related to water re-use opportunities

The industry mostly makes use of municipal water. Although the report mentioned the quality of the water supply as something important for the industry, it was nor registered as a concern or challenge neither was there concern regarding the future availability of this source. This may serve as an opportunity for the industry to be awakened to re-use technologies and interventions in light of the water supply challenges that may come as results of drought and the increased cost of water that may result. The recent case of Cape Town is a good launching pad for such a discussion to be initiated.

3.6 Red meat industry

3.6.1 Sector and water management status quo

The second edition of the national survey for the red meat industry was conducted in 2016 by Jerrard Müller (Müller, 2017). There have been significant changes in the industry since the first survey in 1988. During the first survey, Abakor was the single largest players in the red meat industry claiming 50% of the market share while the other 50 % was shared among 275 smaller abattoirs. It operated 10 large abattoirs with over 100 slaughter units (SU) capacity. When the red meat industry was deregulated in the 1980s it ushered in numerous small players and put Abakor out of operation in the early 90s. In 1988 there were 258 registered abattoirs compared to 432 in 2015. The growth in the industry has also resulted in increased water usage and subsequent generation of highly polluted wastewater.

The red meat industry is generally a water use intensive industry due to stringent hygiene requirements but also general wastefulness in the smaller abattoirs for lack of better water management practices. The high water volumes used in processing meat result in proportionally large wastewater volumes. It was noted in the surveys that water use efficiency was better in the large abattoirs than the smaller abattoirs with more than double the difference. This was attributed to the fact that larger abattoirs are more conscious of their water use and thus use more efficient processes and technologies compared to smaller abattoirs. The difference is so stark that for large abattoirs the average volume of water needed per slaughter unit (SU) ranges between 0.7 kl and 1.2 kl while for smaller abattoirs the average volume is 4.64 kl. On average 82% of the water used in red meat processing is discharged as wastewater.

3.6.2 Current wastewater management

The report does not mention the dominant water sources for the industry although this was asked in the survey according to the questionnaire in the report. However, it can be noted that the industry does rely heavily on a constant supply of clean water to meet hygienic standards. The waste generated

is discharged into the municipal sewer. The larger abattoirs have wastewater treatment processes in place in order to reduce trade effluent penalties and some even have more sophisticated technologies. The rough offal processing stage uses the largest volume of water and generates high strength polluted wastewater which has to be pre-treated before discharge. The disparities between big and small abattoirs regarding their wastewater management practises can be seen in the effluent quality. The average COD values in wastewater from big abattoirs is 1271 mg/l whereas in the smaller abattoirs this value can be as high as 5025 mg/l. The industry COD range is 730 mg/l to 9930 mg/l.

3.6.3 Potential for wastewater re-use

Opportunities for match making can be accessed through the Red Meat Abattoir Association (RMAA) where most of the abattoirs are registered. The RMAA has indicated interest in the match making.

Re-use considerations

The report portrays a greater potential for water use efficiency than there is for water re-use. Water re-use possibilities are mentioned for the stormwater which can be collected and be issued for irrigation. According to the report, research into possibilities for off site usage of treated wastewater can be explored.

Water supply concerns related to water re-use opportunities

Dependent on municipal water supply, but generally water consuming.

3.7 Iron and steel industry

3.7.1 Sector and water management

The survey for the iron steel industry was conducted in 2016 by Marlene van der Merwe Botha, Bertie Steytler and Peter Wille (Van der Merwe - Botha et al., 2017). There was no previous survey prior to this one. The results of the study showed that the industry was currently in recession, facing competition from products produced in China. The main players cooperated in the research: Arcelor Mittal, Evraz, Columbus, SCAW Metals, Highveld, and Cape Gate. Of the six steel companies in SA at the time of the study, one went through business rescue and the other retrenched employees.

The industry is quite advanced in its water management practises and subscribes to local and international regulation as well as it being part of corporate governance practises e.g. sustainability reporting. Large steel companies belong to the South African Iron and steel institute (SAISI). Most of the steel processing plants are located in Gauteng with a few others dotted around the country.

The average specific water intake for the industry is 4.8m^3/t ranging between 2.3-9.3m^3/t. The wide range is due to varying production processes used in the industry. There was however, a significant improvement in the water use performance of plants built after 1990 which recover and re-use wastewater through evaporative processes. Most of the water in the steel industry is used for cooling purposes and the condensate is re-used.

3.7.2 Current wastewater management practices

The industry is already conscious of water management requirements and operates treatment facilities on site such as activated sludge, clarification, evaporation and dissolved air flotation. Treatment of final

effluent is end of pipe, incorporating all wastewater streams from the process. However, some pre-treatment of primary effluent is also undertaken at source for the removal of TSS, ammonia, among others.

3.7.3 Potential for wastewater re-use

Re-use considerations

Most mills had processes in place to recover water for re-use or were in the process of doing so. The ArcelorMittal Vanderbijlpark operations utilise a combination of wastewater treatment processes including, desalination, reverse osmosis and softening to treat wastewater to reusable levels. At the time of survey (2016), some of the mills were installing new effluent treatment technologies there was expected to be an increase the ratio of the treated effluent being re-used in process.

There were considerations of importing treated wastewater from neighbouring industries or re-use in process instead of potable water. Some of the re-use solutions used by the mills include desalination of effluent. The report indicates that at two sites (Saldanha Bay and Columbus) the original design had been based on zero effluent discharge (ZED).

Water supply concerns related to water re-use opportunities

The sources of water for the mills was either raw water, municipal water and treated effluent. The re-use of effluent secures the water supply for the industry as a 40% reduction in the use of fresh water was reported after the integration of effluent treatment technologies. For the zero effluent plants reported, no further reductions in raw water intake were foreseeable.

3.8 Metal finishing industry

3.8.1 Sector and water management

The national survey for the metal finishing industry was carried out in 2015 by S.H Ally, W. Kamish, and A van der Spuy (Ally et al. 2016). This was a follow up, updated report for the first survey carried out in 1987. The metal finishing industry as reported in this report is responsible for electroplating of metals. There are two broad categories of metal finishing operations in SA; In house finishing operations (original equipment manufacturers and automotive manufactures) and commercial finishers which provide finishing services to companies. The in-house finishing segment has seen steady growth due to better quality and resource control. It was difficult to quantify the industry due to it being part of a larger manufacturing industry, but the metal finishing processes include: electroplating, anodising, galvanising, powder coating, painting etc.

It is noted that there have been significant changes in the industry since the first survey, which has resulted in somewhat improved cleaner production practises. However, there is still widespread use of toxic raw material and chemicals. The uses of Cyanide and Chromium (VI and III) are still being practised in the industry. The researchers suggest a study into the barriers to cleaner production practises in the industry. Metal finishing industries subscribe to the South African Metal Finishing Association (SAMFA) but are regulated by local and national regulations.

The knowledge and therefore practise of water management practises in the industry is very limited resulting in only 16% of the surveyed industries knowing how much water they actually use. Water management is thus poor in the metal finishing industry and is not prioritised. In-house facilities usually

are more advanced in their operational processes and are signatories to international standards such as ISO. This is because they are a part of larger companies and have budget for such interventions, some of them belong to multinational companies who have to adhere to other standards.

3.8.2 Current wastewater management practises

Water based metal deposition requires significant volumes of water and therefore generates a large amount of waste water. Minimising material loss ensures that the depositoins are not washed out into the wastewater.

Rinsing processes also form a water intensive use in the metal finishing industry. Typical pollutants include metals, organic matter, hypochlorite, chlorine, acid and alkalis, solvents etc. The industry generally treats its wastewater before discharge. The Province of KwaZulu Natal was found to have the highest number of non-compliant industries (31%) to effluent standards.

Wastewater treatment interventions currently being used are neutralisation, precipitation, oxidation, reduction, filtration, reverse osmosis etc. However, some of the WWTPs are operating above capacity and therefore discharging poor quality effluent. Local authorities were not regularly monitoring facilities and some had never been monitored at all. This lack of enforcement as led to some facilities operating without trade effluent permits (appr. 33%)

3.8.3 Potential for wastewater re-use

The commercial finishers are a good target for matchmaking technologies as they were found to perform poorly in water management according to the study.

Re-use considerations

There is scope for water re-use in the metal finishing industry and more needs to be done by this industry to implement better water management interventions. The fact that many of them did not know their specific process water usage indicated that there is not much considerations for reducing water use or re-use. Multiple re-use of rinse is one such suggestion presented in the study.

Water supply concerns related to water re-use

While the industry is reliant on consistent municipal water supply, there are no interventions in place to ensure water security such as water recycling and re-use.

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