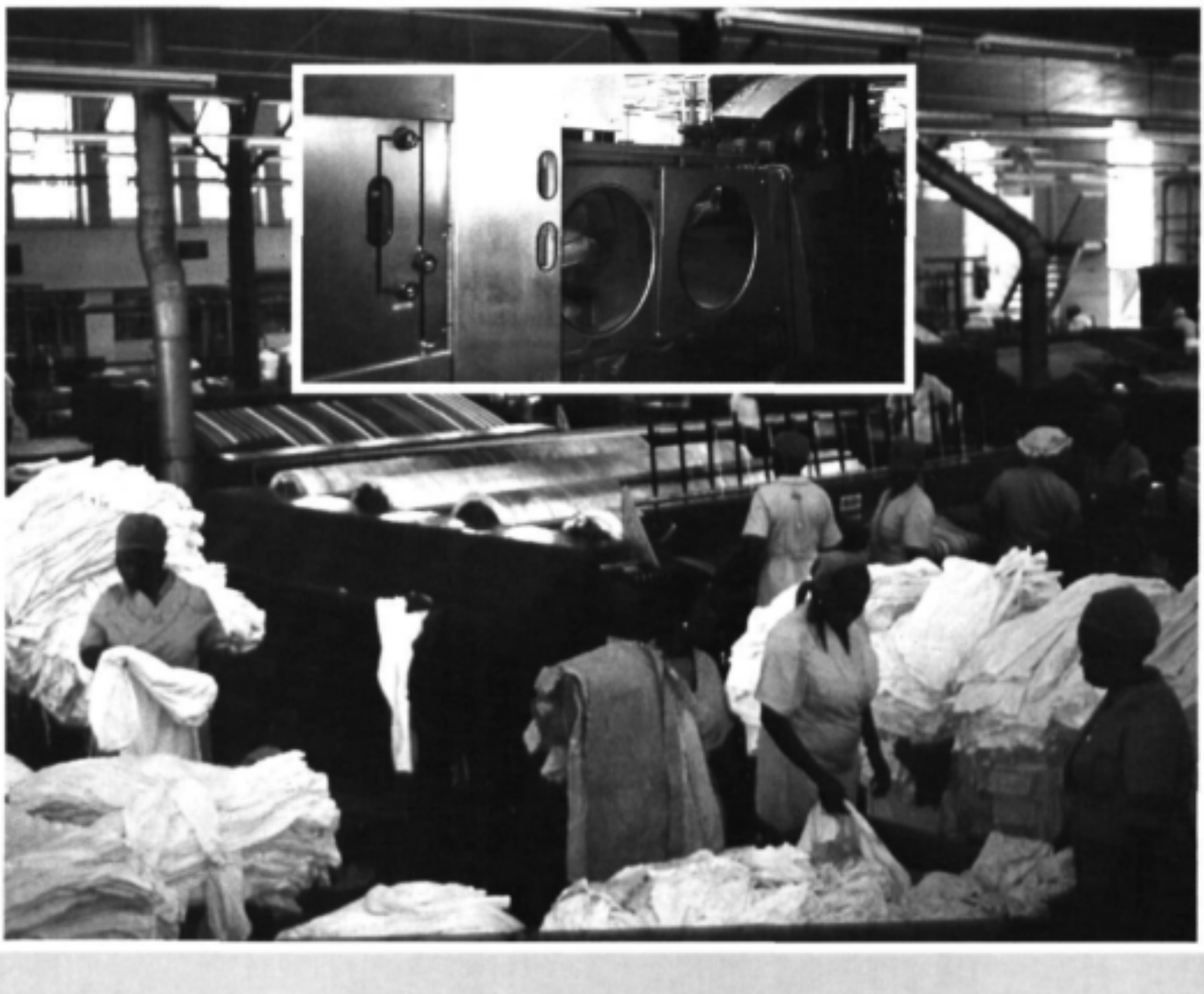
NATSURV 8

WATER AND WASTE-WATER MANAGEMENT IN THE LAUNDRY INDUSTRY



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WATER AND WASTE-WATER MANAGEMENT IN THE LAUNDRY INDUSTRY

PREPARED FOR THE
WATER RESEARCH COMMISSION

BY

STEFFEN, ROBERTSON AND KIRSTEN INC
CONSULTING ENGINEERS

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Consulting Engineers

Steffen, Robertson and Kirsten
16th Floor
20 Anderson Street
JOHANNESBURG

PO Box 8856
JOHANNESBURG
2000
Tel. 492-1316

FOREWORD

The need for guidelines to reduce water intake and waste-water discharge by industry is of national concern 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 Steffen, Robertson and Kirsten, a firm of consulting engineers, to undertake a National Industrial Water and Waste-water Survey (NATSURV) of all classes of industry. The consultants identified 75 industrial groupings in South Africa, one of which is the laundry industry. The results obtained in the survey of the laundry industry form the basis of this Guide on Water and Waste-water Management in the Laundry Industry.

It is expected that this Guide will be of value to the industry itself and to other interested parties such as municipalities, administrators, researchers and consultants in the water and waste-water fields.

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Dr OO Hart	Water Research Commission
Mr DF Sutton	Department of Water Affairs
Mr P Skivington	Steffen, Robertson and Kirsten
Mr EP Rossouw	Steffen, Robertson and Kirsten

SUMMARY

Laundries in South Africa use an estimated 3 million m^3 of water per annum and 95% of this is discharged as waste water. The weighted average specific water intake was found to be 15,1 l/kg of laundry washed with a range of values of 8,0 to 58,4 l/kg encountered. Laundries employing rinse water recycle were found to have an SWI of about 9 l/kg while those not employing rinse water recycle had an SWI of about 30 l/kg. A target SWI of 8 l/kg is proposed for laundries employing rinse water recycle and 20 l/kg for those not recycling rinse water.

It is recommended that those laundries which do not recycle rinse water should seriously consider implementing a rinse water recycle system.

The weighted average specific pollution load was found to be 8,8 g COD/kg, 19,8 g TDS/kg, 2,6 g SS/kg and 0,7 g PO_4-P/kg. Target figures corresponding to these industry averages are proposed for TDS and PO_4-P. No targets are proposed for COD and SS as these are largely a function of the nature of the laundry to be washed.

GLOSSARY

CHEMICAL OXYGEN DEMAND - a measure of the oxygen equivalent of organic matter content of a sample and therefore an indicator of pollution potential.

TOTAL DISSOLVED SOLIDS - the mass of solid material dissolved in water or waste water which is deposited as a residue after heating a sample to 180 °C.

SUSPENDED SOLIDS - the mass of solid material present in an undissolved state in water or waste water that is retained on a 0,45 micron filter paper.

PHOSPHATE - the most common form of phosphorus found in waters and waste waters. It is a nutrient and can stimulate the growth of aquatic micro and macro-organisms in nuisance quantities, hence it is undesirable in waste-water discharges.

SPECIFIC WATER INTAKE - the volume of water used per kilogram of laundry washed.

SPECIFIC POLLUTION LOAD - the mass of contaminant discharged in the waste water per kilogram of laundry washed.

ABBREVIATIONS

COD	-	Chemical oxygen demand
PO_4-P	-	Phosphate (as phosphorus)
RO	-	Reverse osmosis
SPL	-	Specific pollution load
SS	-	Suspended solids
SWI	-	Specific water intake
TDS	-	Total dissolved solids
UF	-	Ultrafiltration

CONTENTS

1 INTRODUCTION

Laundries in South Africa are defined for the purposes of this document, as including private and public sector establishments, not including laundromats. They are therefore very widely distributed and can be found in virtually every town in the country.

The annual water intake by laundries in South Africa is estimated to be in the region of 3 million m^3. Approximately 95% of this is discharged as waste water, the remainder being lost in drying. Waste water from a laundry will contain the following contaminants: starch, phosphorous compounds, nitrogenous compounds, suspended matter and oils and greases. The waste water can contain a high organic load as well as considerable quantities of dissolved salts.

The data presented in this guide have been collected from detailed surveys carried out at 16 separate laundries.

2 PROCESS RÉSUMÉ

The laundry process is relatively simple and is often identical to that carried out in a domestic situation. During the washing stage, dirt is removed from cloth by agitation in an alkaline, aqueous medium containing a detergent. The suspension formed is stabilized to prevent re-deposition of dirt on the cloth. The purpose of subsequent rinsing is to remove the stabilized suspension of dirt from contact with the article being washed.

The laundry industry can use up to four washing and four rinsing steps. However, a two-wash, two-rinse process is normally adequate for most applications. Rinsing operations tend to use considerably greater volumes of water than washing. Water is normally heated by direct steam injection. Some laundries discharge virtually all of their water intake as waste water. Many, however, employ recycling of rinse water for reuse as wash water and thus achieve considerably improved water efficiency.

3 SUMMARY OF SURVEY RESULTS

3.1 Specific water intake

Table 3.1: Specific water intake for laundries surveyed

	Water intake (m^3/d)	Laundry washed (kg/d)	SWI ℓ/kg
Range	10 - 1 036	320 - 35 800	8,0 - 58,4
Mean	245	16 275	15,1 (weighted average)

NB. Size of laundry appears to have no influence on the SWI

The weighted average SWI was found to be 15,1 l/kg and the range of SWI was 8,0 to 58,4 l/kg. It is important to note that the laundries employing water recycle fell into a range of SWI of 8,0 to 16,7 l/kg with a typical SWI of 9,0 l/kg while those without water recycle facilities fell into the range 23 to 58,4 l/kg with a typical SWI of about 30 l/kg. It can clearly be seen that recycle of water in laundries is very influential in determining SWI figures. These can be compared with figures quoted[1] of 10 to 30 l/kg for laundries with water reuse facilities and 40 to 120 l/kg for laundries without reuse facilities. No evidence was found that size of laundry or type of articles to be washed had any influence on SWI. Recycle of rinse water was found to be more common in hospital laundries than in commercial laundries.

3.2 Breakdown of intake water use

Table 3.2 gives a comparison between the water intake for a laundry not recycling rinse water and one where rinse water recycle takes place.

Table 3.2 : Water use for a typical laundry

	Percentage	Breakdown of SWI (ℓ/kg)	Percentage	Breakdown of SWI (ℓ/kg)
	Non recycle		Recycle	
Washing	32%	9,6	9%	0,8
Rinsing	56%	16,8	73%	6,6
Steam generation	12%	3,6	18%	1,6
	100%	30,0	100%	9,0

Again it can be seen that recycle of rinse water for reuse as wash water can result in significant overall reduction in water intake.

Water intake patterns are very similar for all sizes of laundry except for the very small ones where heating of water is by electrical means rather than by direct steam injection.

3.3 Waste water

3.3.1 Specific parameters

Composite samples of raw waste water were collected at 16 laundries and the results summarized in Table 3.3.

Table 3.3: Waste-water quality data from laundries surveyed

	Determinand				
	pH	COD (mg/ℓ)	TDS (mg/ℓ)	SS (mg/ℓ)	PO_4 -P (mg/ℓ)
Wash water					
Range	10,1-11,6	285-1 400	770-4 900	97-940	22-110
Mean	11,1	890	2100	255	69
Rinse water					
Range	6,9-9,7	30-80	70-220	11-70	2-19
Mean	8,6	60	115	54	11
Final waste water					
Range	6,9-10,2	196-1 300	540-4 322	36-798	5-97
Mean	9,1	625	1400	184	51

NB. Size of laundry appears to have no influence on the figures

Concentrations of contaminants in the final waste water to drain were generally higher for laundries employing recycle of rinse waters. Rinse waters were found to be very much less contaminated than wash waters and generally seemed to be suitable for reuse as wash water.

COD values for rinse waters were in the range 30 to 80 mg/l, TDS values 70 to 220 mg/l, SS values 11 to 70 mg/l and PO_4-P values 2 to 19 mg/l. Again size of laundry did not seem to influence the specific pollution load and neither did the type of article to be washed; though most laundries surveyed handled a large variety of articles making drawing conclusions about specific types of laundry items impractical.

Table 3.4: Specific pollution loads for laundries surveyed

	Waste water (m^3/d)	Laundry washed (kg/d)	Specific pollution load			
			COD g/kg	TDS g/kg	SS g/kg	PO_4-P g/kg
Range	9-974	320-35 800	2,2-20,7	7,1-74,3	0,4-16,1	0,1-2,1
Mean or weighted average*	230	16 275	8,8*	19,8*	2,6*	0,7*

4 WASTE-WATER TREATMENT

4.1 Introduction

Waste-water treatment can be aimed at either treating waste water for disposal to sewer or elsewhere or for treating waste water to a quality suitable for reuse. Either the final waste water, the rinse water or a combination of both can be treated; though for recycle purposes it is most common to deal with the rinse water only as it is very much less contaminated than the final waste water.

Waste-water treatment need not be costly. Indeed, it would unwise to proceed with sophisticated waste-water treatment processes without having first implemented and assessed the effectiveness of more simple, less costly options.

4.2 Control of pH and solids removal

As a first stage simple pH control and solids removal could be considered. The control of pH within certain limits is necessary because municipalities receiving waste water in their sewerage systems generally apply limitations to the pH range of the waste water which they will receive. This range is usually from pH 5 to pH 9.

Waste water with a pH outside this range (and laundry waste water pH often falls outside this range) may incur extra charges from the municipality for disposal of this waste water. Correction of this pH to a more acceptable level can be easily achieved by dosing the waste water with an acidifying chemical. Obviously, the cost of the chemical dosing should not exceed the saving realizable in the effluent tariff charges.

Solids most likely to occur in laundry waste waters would be colloidal in nature or very small, solid particles in suspension in the waste water. Colloidals will not settle out unaided so coagulation and flocculation chemicals can be added to assist in the sedimentation process. The chemicals used are water-soluble electrolytes and polymers. The coagulation/flocculation process should be carried out in a specially designed basin or tank to promote floc growth and settlement. These tanks may be circular or rectangular vertical flow, radial flow or horizontal flow types. Thus, for a relatively small capital outlay for a settling tank and some chemical dosing equipment, a considerable improvement in the quality of the waste water can be expected, with concurrent savings in municipal waste water treatment charges.

4.3 Further treatment processes

For further treatment of laundry waste waters, perhaps for reuse as rinse water as well as wash water, more sophisticated treatment may be necessary.

Crossflow microfiltration is a pressure-driven filtration process for the removal of suspended and colloidal particles and could be considered even as an alternative to the coagulation/flocculation and settling process described in Section 4.2.

Another alternative to sedimentation for the removal of solids is dissolved air flotation. Commercial flotation plants are available but the design parameters must be correctly selected. The process operates by dissolving air under pressure in the waste water and then allowing this waste water to suddenly return to atmospheric pressure. The dissolved air forms tiny bubbles which adhere to any solid material in the waste water and float them to the surface where they can be removed easily.

As a further processing stage ultrafiltration (UF) could be considered[2]. In this process membranes are used to mechanically separate suspended solids from a liquid solution. The UF process can be used to separate out large organic molecules from solutions.

Treated waste water (after dissolved air flotation and/or UF), as far as bacteriological quality is concerned, has been found[1] to have no E. coli I bacteria present. If necessary, the treated waste water could be chlorinated prior to reuse.

It must be emphasized that these processes are all capital intensive and would only be worth considering as a second stage after simple waste-water treatment and management measures had been implemented.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Water intake

It was found during this study that the range of SWI for laundries was 8,0 to 58,4 l/kg with a weighted average of 15,1 l/kg. Targets are proposed of 8 l/kg for laundries employing recycle of rinse waters and 30 l/kg for laundries not recycling, though these laundries would be urged to consider recycling of rinse waters very seriously.

5.2 Recommendations for reducing water intake

The variations in SWI for laundries, even disregarding the influence of water recycle, indicate that considerable opportunities exist for improved water management. This can be achieved by considering the following:

a) optimizing water recycle systems to make best use of higher quality waters;
b) treatment of rinse waters to render them of higher quality and therefore of greater potential for reuse;
c) designing any new equipment (both washers and rinsers) to ensure efficient water use;
d) optimizing operation of boilers by minimizing unnecessary blowdown;
e) installing water meters at all key areas of the laundry process line;
f) monitoring and taking action on water meter figures;
g) ensuring that staff are trained to appreciate the need for water conservation in the laundry;
h) ensuring that equipment automatically switches off when loads of washing are being transferred from one stage to another;

i) floor washing hoses should be equipped with automatic shut-off mechanisms; and

j) maintaining equipment in good order to minimize leaks.

5.3 Waste water

It was found that waste water varied widely in quality as can be seen in Table 3.4. Targets are proposed for TDS and PO_4-P of 19,8 g TDS/kg and 0,7 g PO_4-P/kg, corresponding to these industry means. By striving to achieve these targets cost benefits in reduced waste-water disposal costs can be realized.

It should be noted that COD and SS figures are influenced by the nature of the laundry to be washed and therefore targets have not been proposed for these parameters. TDS and PO_4-P figures however, are largely influenced by what is put into the water to achieve the cleansing effect. These can include sodium hypochlorite, soda ash, oxalic acid, starch and a variety of commercial soaps and detergents.

Excessive use of chemicals is not cost-effective and by controlling chemical dosages, reductions in TDS and PO_4-P concentrations in laundry waste waters can be expected.

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