AUSTRALIAN CAR WASH ASSOCIATION

EVALUATION OF RECYCLING SYSTEMS FOR THE VEHICLE CLEANING INDUSTRY PROJECT SUMMARY

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Executive Summary

The aim of this project has been to evaluate water recycling equipment used in Australian car washes, and to provide feedback from that evaluation to car wash owners, operators, manufacturers and regulators. The development of a framework for risk management in relation to car wash water recycling also featured as an intended aim of this work. The intended outcomes from this are to support further reductions in the use of potable water for car washing, provide car wash owners with confidence and tools for assessing and operating their water recycling systems and improve public confidence and support in the safety and effectiveness of car wash water recycling systems.

This project was initiated by the Australian Car Wash Association (ACWA), funded by the Victorian Smart Water Fund and managed by Ecowise Environmental. ACWA's environmental commitment is to develop and promote environmentally sustainable practices which impact on or are a consequence of the vehicle washing industry. The Smart Water Fund provides funding for innovative water conservation initiatives to individuals, community groups, businesses and research bodies in metropolitan and regional Victoria. Ecowise is an Australian owned and managed company that provides a wide range of specialised analytical, monitoring and consulting services.

The project included a comprehensive risk assessment using the principles of hazard analysis and critical control point (HACCP), as well as two stages of data collection; an initial screening site assessment and detailed monitoring.

The following lists the major conclusions drawn from the project:

- *the highest risk associated with car wash water recycling is the presence of pathogens in treated water;*
- *metals concentrations in the recycled water were generally found to be acceptable;*
- *E. coli concentration in source water is generally greater when the source water is drawn from self serve bays as well as auto bays;*
- *the higher exposure expected from washing cars in self serve bays means a higher risk in recycling water to self serve bays;*
- *the difference in source water E. coli concentrations between urban and regional sites could not be confirmed as statistically significant;*
- *low BOD and suspended solids in the treated effluent results in better disinfection performance by chlorination;*
- *pH in the final effluent was generally found to be within desirable limits;*
- *disinfection performance between sites varied dramatically;*
- *chlorine was generally found to be a more effective disinfectant, due in part to its ability to maintain a residual in stored water post treatment. It was also found to be easier to monitor than other disinfection methods;*
- *microbial re-growth in stored treated water is a concern if a disinfection residual cannot be maintained;*

- *operation and maintenance of car wash water recycling systems is key in reducing the risks posed by on-site car wash water recycling, and these practices were found to vary dramatically between sites;*
- *site specific risk management plans were demonstrated as an effective way to engage with car wash owners and operators and improve operation and maintenance around the recycling process;*
- *water quality monitoring is highly variable making the development of a clear and consistent test protocol with a "pass/fail" type outcome difficult; and*
- *the Guidelines for Water Recycling in the Commercial Car Washing Industry that were developed on the back of this study, should inform car wash owners of the risks associated with car wash water recycling and assist them in choosing a suitable process configuration for their application.*

1 HACCP ANALYSIS

1.1 The HACCP Analysis Risk Assessment

A comprehensive risk assessment, using the principles of hazard analysis and critical control point (HACCP) was conducted on thirteen different configurations of recycled water treatment systems specifically designed for car washing. This was done in order to identify knowledge gaps and areas where information needed to be collected in the subsequent initial screening site assessment monitoring program.

The systems were chosen based on their distinct process configurations and market share. Each system had a combination of at least some typical treatment processes including hydrocyclones, filtration, flocculation, biological treatment, ozonation and chlorination, to name a few.

Risk assessments were conducted on source water, thirteen treatment system configurations identified as being in the marketplace, the impact of recycled water on car wash equipment and wash quality and the impact of recycled water on human health.

1.2 Conclusions

The highest risks found from the HACCP analysis were mainly associated with the presence of pathogens in the treated water, which could result from treatment systems failing to adequately remove pathogens, or from the provision of suitable conditions for opportunistic pathogens to multiply.

Critical control points were identified at the source and treated water and at various stages throughout the treatment process depending on the process, usually at the treatment unit that is intended to remove pathogens.

The following items were identified as areas where validation during the initial screening site assessment was recommended:

- source water quality (turbidity, nutrients, total petroleum hydrocarbons, oil and grease, pesticides, herbicides, anionic and non-ionic surfactants, heavy metals, and indicator microorganisms);
- level of training received by car wash operators;
- level of maintenance on recycled water treatment systems;
- effectiveness of disinfection processes if used;
- retention time and temperature of water in holding tanks;
- likelihood of process unit failure;
- final effluent quality (turbidity, oil and grease, anionic and non-ionic surfactants, and indicator microorganisms); and
- likelihood of cross contamination through incorrectly installed plumbing fixtures.

2 INITIAL SCREENING SITE ASSESSMENT

2.1 Initial Screening Background

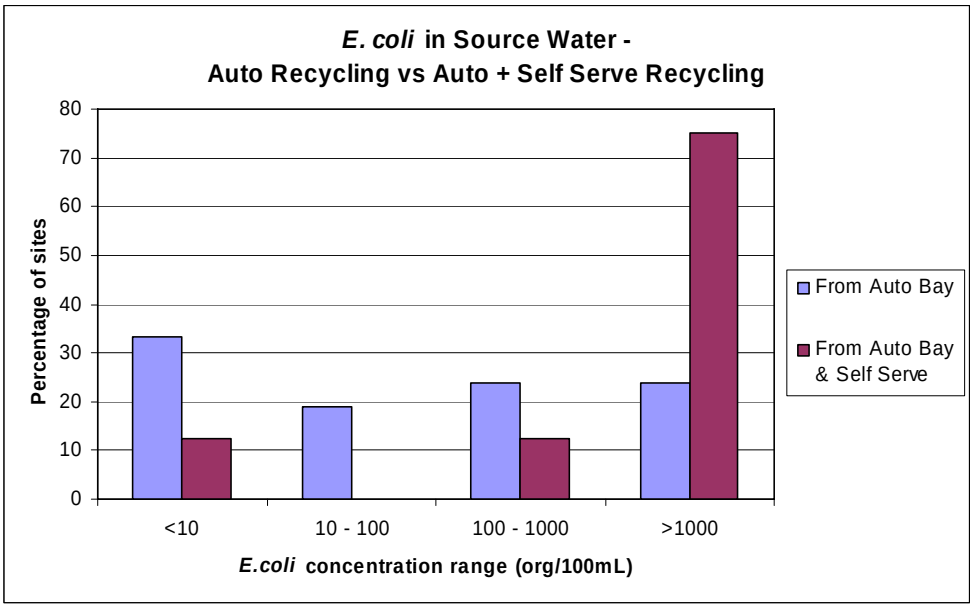
The initial screening site assessment was aimed at validating some of the assumptions made and conclusions drawn in the HACCP analysis. 32 sites were randomly selected, ensuring that there was adequate representation from each of the 11 system types involved, urban localities and regional localities. One off sampling events were carried out at each of the selected sites during which samples were collected of both source water and final effluent and analysed for a range of parameters. A questionnaire addressing some of the qualitative issues identified in the HACCP analysis was also completed by the on-site car wash staff during the sampling event. This also helped to gauge the operation and maintenance practices in relation to the water recycling system.

2.2 Conclusions

The results from the initial screening indicated most significantly that:

- metals concentrations in the recycled water were generally found to be acceptable;
- observed pH was within desirable limits across all sites;
- *E. coli* concentration in source water is generally greater when the source water is drawn from self serve bays as well as auto bays indicating higher risk when recycling a combined feed (see Figure 1);

Figure 1 - Source water *E. coli* concentration



- The difference in source water *E. coli* concentrations between urban and regional sites could not be confirmed as statistically significant;
- pathogen risks with car wash water recycling need more investigation;
- no firm conclusions could be drawn on effects of specific detergent used on the recycling system performance; and
- disinfection performance between similar systems was variable suggesting that operation and maintenance practices are variable from site to site.

2.3 Recommendations

As such, it was recommended that the detailed monitoring phase of the project proceed with a system validation approach incorporating the following objectives:

- Development of a validation protocol against which to test the performance of the systems. The protocol should fall in line with existing guidelines and should also have a focus on operation and maintenance issues and pathogens (as this was identified as the highest risk area in the HACCP and confirmed by the initial screening).
- selection of sites to be involved in pilot validation trials. The sites should adequately represent each system type, have appropriate sample points and be suitably accessible to sampling staff;
- development of a pro forma risk-based management template to be implemented at each of the chosen sites. It will aim to ensure that operation and maintenance issues are addressed adequately at each site prior to the commencement of the validation; and
- detailed validation monitoring as per validation protocol.

3 DETAILED MONITORING

3.1 Detailed Monitoring Background

Detailed monitoring was designed to build more data around specific system configurations over a lengthier testing period. The pilot validation program was carried out on 12 sites representing 12 different system configurations or variations, for a total of 5 sampling events over a 5 week period. The pilot validation was focused on disinfection performance through *E. coli* inactivation, and the operation and maintenance of the system. The sites involved in the pilot validation were chosen based on the proper management practices expected of them, so that the results represented what the system should be capable of when operated appropriately.

Since the pilot validation trial was to focus on the inactivation of E. coli, it was necessary to determine a log reduction target through the completion of a microbial risk assessment of E. coli. This was done in line with the Australian Guidelines for Water Recycling (AGWR) using the data obtained in the initial screening. Car wash water recycling source water was related to greywater and stormwater, but it was concluded that it be more appropriately aligned to stormwater due to the lower concentration of human waste originated pathogens expected in car wash source water compared to greywater. As a result of the risk assessment, it was shown that a tolerable level of risk from bacterial pathogens to full time staff would be achieved with 1.1 log removal of E. coli. By comparing the source water to stormwater, consideration was given to the likelihood that microbial contaminants present in source water are probably derived from wildlife and domestic pets rather than humans. This effectively reduces the estimated numbers of viral and protozoan pathogens in source water and therefore implies a lower risk in terms of these organisms. This tends to suggest that there is a minimal risk in terms of viruses and protozoan pathogens from car wash water recycling, however further study could be done to validate the assumptions made. A risk management template was implemented at each site to form a site specific risk management plan. The template was set up as a questionnaire that contained sections on the major critical control points identified in the HACCP analysis, acting as a check list for risk control measures. It also provided spaces for operating procedures for on-site staff to be documented.

3.2 Conclusions

The results from the detailed monitoring indicated most significantly that:

- water quality monitoring is highly variable making the development of a clear and consistent test protocol with a “pass/fail” type outcome based on a log reduction target difficult;
- source water *E. coli* concentrations obtained from detailed monitoring (n=60) were comparable to those obtained in initial screening (n=32) indicating some confidence in the spread of data around this parameter;
- statistical analysis of the results suggested a correlation between the physiochemical parameters (BOD and suspended solids), and *E. coli* concentration when chlorination is the disinfection method, highlighting that low BOD and suspended solids in the treated effluent results in better disinfection performance by chlorination;
- operation and maintenance of the recycling systems is a very important factor in reducing risks posed by car wash water recycling and site specific risk management plans were

demonstrated as an effective way to engage with car wash owners and operators to improve quality control; and

- microbial re-growth in stored treated water is a concern if a disinfection residual cannot be maintained.

3.3 Recommendations

The subsequent recommendation to be taken away from the detailed monitoring was to move away from testing system performance against a log reduction target and produce a guideline document outlining best practice in the management of water quality risks in car wash water recycling systems. The document should contain a risk management plan template and non-mandatory, indicative water quality testing guidelines.

4 BEST PRACTICE GUIDELINES

As per the detailed monitoring recommendations, it was decided that rather than develop a protocol that gave parameters against which car wash water recycling systems could be measured to determine whether they pass or fail, all of the data and findings from both the initial screening and detailed monitoring should be compiled and a guideline document outlining best practice in the management of water quality risks in car wash water recycling should be developed.

These guidelines are designed to provide information to car wash owners about the risks associated with on-site water recycling and assist them through decision making processes. The guidelines contain a risk management plan template (the same one that was successfully trialled in the detailed monitoring stage), indicative source water and final effluent water quality characteristics, indicative water quality guidelines and sampling guidance. They have been structured to be user friendly to car wash owners and also contain a simple self diagnosing risk assessment, as well as a list of questions that owners should ask recycling system manufacturers before choosing a system configuration. Accompanying the questions is a rationale as to why the question is importance and what the answer to the question should contain.

These guidelines encapsulate all stages of the research study and will be made available to the car wash industry via the ACWA website, and to the public via the Smartwater website. It is anticipated that they will provide car wash owners with a wealth of information about the risks associated with recycling car wash water and what they should look for in a water recycling system. They are the major industry use output from the project.

5 FINAL PROJECT CONCLUSIONS

Conclusions to be taken away from this study into recycling systems for the vehicle cleaning industry are:

- the highest risk associated with car wash water recycling is the presence of pathogens in treated water;
- metals concentrations in the recycled water were generally found to be acceptable with the exception of antimony. A risk assessment showed that the maximum antimony concentration observed would not present a health risk to full time employees;
- *E. coli* concentration in source water is generally greater when the source water is drawn from self serve bays as well as auto bays. It is therefore considered a higher risk when recycling a combined feed and a much lower risk when recycling water from the auto bay/s only;
- the higher exposure expected from washing cars in self serve bays means a higher risk in recycling water to self serve bays, therefore this is not recommended;
- the difference in source water *E. coli* concentrations between urban and regional sites could not be confirmed as statistically significant. Therefore the study was unable to confirm whether recycling car wash water from a regional site poses a higher risk than recycling from an urban site;
- despite the use of wash chemicals with varying pH values, the pH in the final effluent was generally found to be within desirable limits;
- disinfection performance between sites varied dramatically;
- chlorine was generally found to be a more effective disinfectant, due in part to its ability to maintain a residual in stored water post treatment. It was also found to be easier to monitor than other disinfection methods;
- low BOD and suspended solids in the treated effluent results in better disinfection performance by chlorination;
- microbial re-growth in stored treated water is a concern if a disinfection residual cannot be maintained;
- operation and maintenance of car wash water recycling systems is key in reducing the risks posed by on-site car wash water recycling, and these practices were found to vary dramatically between sites;
- site specific risk management plans were demonstrated as an effective way to engage with car wash owners and operators and improve operations and maintenance around the recycling process;
- water quality monitoring is highly variable making the development of a clear and consistent test protocol with a “pass/fail” type outcome based on a log reduction target difficult;
- an indication of best practice performance in terms of BOD and suspended solids is given in the form of non-mandatory, indicative guideline values for these parameters in the guideline document; and

- the Guidelines for Water Recycling in the Commercial Car Washing Industry that were developed on the back of this study, should inform car wash owners of the risks associated with car wash water recycling and assist them in choosing a suitable process configuration for their application.