

# WATER EFFLUENT AND SOLID WASTE CHARACTERISTICS IN THE PROFESSIONAL CAR WASH INDUSTRY

A Report for the International Carwash Association



**International  
Carwash Association**  
*Serving the Professional Car Care Industry*

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## **Executive Summary**

The International Carwash Association has dedicated much of its effort to evaluating the impact of our industry on the environment. To better educate individuals on the influence of professional car washing, we have conducted a series of studies as part of our strategic plan to provide industry leadership by being recognized as the source for accurate information.

The International Carwash Association has completed a two-year study that is designed to gather and analyze data regarding wastewater discharges, as well as contaminant levels in solid wastes. Professional car washing is unique in the fact that it has the capability of collecting both discharges of water and solid waste.

Local municipalities have the responsibility to ensure that all water collected from streets, gutters and drainage ditches do not impair the quality of receiving waters such as our lakes, streams and aquifers. Pollutants found in this study that are of concern include, oil and grease and chemical oxygen demand which are found in the effluent from car washing. Professional car washing is a non-point source of discharge that has the ability to capture these contaminants that undergo treatment before they are released into our sanitary systems. Unlike, storm water that does not undergo treatment before being emitted into our waterways.

Data collected from in-bay automatic car washes, self-service car washes and conveyor car washes in different climatic locations were chosen to determine if regional differences in climate and geography had a significant impact on the contents of the water or solid waste.

It is imperative that our businesses take proactive measures in both quantity and quality of water as it relates to the professional car washing industry. It is important to the car care community that awareness is created not only of the amount of water we use, but what is contained in the waste water and solid waste collected from our businesses. This study is the first of its kind in taking a proactive measure of measuring the effects of collection in the professional car care industry and to demonstrate how this industry can alleviate the increasing cost of treating effluent prior to a return state of usage.

This study is made available to all of those in our industry who can benefit from its conclusions and will be available to download on [www.carcarecentral.com](http://www.carcarecentral.com). The International Carwash Association is an ‘industry driven, membership organization’ whose goals include providing for the continued success of all participants in the car care community. If you have any questions about the contents of this report, please contact the International Carwash Association via the Website, [www.carcarecentral.com](http://www.carcarecentral.com).

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## INTRODUCTION

Chris Brown Consulting has prepared the following report for the International Carwash Association to present the findings of the Water Effluent and Solid Waste Characteristics in Professional Car Washes Study. This section includes the results of water quality testing of effluent of the thirty professional car washes studied. Solids removed from the oil/water separators of twenty-four of the sites were also tested. The study was performed in three regions of the country: the arid southwest, the humid northeast and the humid southeast. The results of the water consumption section of the study were published in an earlier section, *Water Use in the Professional Car Wash Industry*. This report focuses on water quality and pit sediment analysis.

The objective of this study was to gather and analyze data regarding fresh water consumption, wastewater discharges, as well as contaminant levels in solid and liquid wastes. This report presents the overall findings of the study and an evaluation of water quality among the various facilities, types, and regions.

Within each study region, several facilities were selected from each of three car wash types: conveyor, in-bay automatic, and self-serve. The scope of work for each of the study sites included the following tasks:

- Performing an audit of the site including a review of water use operations;
- Collecting wastewater and grit samples for chemical analysis; and
- Measuring fresh water consumption and wastewater discharge.

In Phoenix, Arizona, three sites from the self serve and the in-bay automatic categories were evaluated by Black and Veatch Engineers. An earlier study done by Black and Veatch in the Phoenix area examined conveyor carwashes for the City of Phoenix (Kobrick, 1997). The other two regions, Boston, Massachusetts and Orlando, Florida, included four car washes in each of the three categories, and data was collected by Oak Engineers.

## **Water Use And Water Quality Issues In Professional Car Washes**

The professional car wash industry uses water, cleaning solutions and finish products, to clean mobile vehicles. Over time there have been many changes in cleansing and finish products. However, in the early 1980s the EPA concluded that the types and quantities of soil present on the vehicle have a major effect upon the effluent characteristics (EPA, 1982). Greater than 99 percent of professional car washes discharge effluent to a sanitary sewer and publicly owned treatment works (POTW).

From both a practical and a regulatory basis it is the POTW that provides pretreatment guidance or rules for discharge limits. This is usually accomplished through local municipal ordinance or regulation of a sanitary sewer district. Regulatory structures will be examined in the following section. Pretreatment in a professional car wash is accomplished through a tank, or series of tanks, that are known as an oil/water separator or a clarifier. The tank is usually buried underground and water from the car wash drains by gravity into the first compartment which is separated from following compartments by a baffle or piping which allows only water from within the tank below the surface to flow into subsequent compartments of the separator. The tank, or tanks, needs to be large enough in volume so that the water slows and heavier particles are allowed to drop out, while oil and grease, with specific gravity lighter than water, rise to the surface and are captured in the initial compartment.

Grit collected in the oil/water separator is pumped out on a periodic basis, dewatered and sent to a properly licensed landfill. Proper chain of custody and testing of materials is maintained by the waste disposal industry, which services commercial car washes in most communities. The growing public concern for the health and safety of the public water supply and the environmental health of streams, rivers and waterways has led to a number of environmental regulatory structures designed to protect our drinking water and watersheds.

## **REGULATORY**

Under implementation of the Clean Water Act of 1972, the federal Environmental Protection Agency (EPA) was charged with the responsibility to issue effluent limitation guidelines, pretreatment standards, and new source performance standards for a number of different industries, including car washes. In 1982 the EPA released its findings that while toxic contaminants were found in the effluent of commercial car washes, the levels found were insignificant (EPA, 1982). Therefore no federal regulations for discharge limitations have been issued specific to commercial car washes. Regulatory limits may be issued by the states or by local ordinance of municipalities or sewer districts. States regulations or local ordinances may be more stringent, but may not be more lenient than Federal standards. Thus each car wash owner/operator must be aware of and comply with local discharge limitations.

### **National Pollutant Discharge Elimination System**

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program regulates point sources that discharge pollutants into waters of the United States. Point sources are distinct conveyances such as pipes or man-made ditches. Individual homes and businesses that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters (EPA, 2002).

In 1999, the stormwater collection systems, controlled by almost all-municipal systems in the United States, came under the restrictions of the NPDES. It is the responsibility of local municipalities to ensure that water collected from streets, gutters, and drainage ditches, do not impair the quality of receiving waters. Some pollutants of concern include oil and grease and chemical oxygen demand, which are contaminants, found in the effluent from car washing.

Cars that are washed in the street can pollute streams, rivers, bays and estuaries. The soaps, oil and grimes that run off the car into the gutters, go into the stormwater system. Stormwater, unlike the water that enters the sewers, does not undergo treatment before it is discharged into waterways. Any pollutants in stormwater end up in our lakes, rivers, harbors and oceans, and are considered non-point source pollution (EPA, 1994).

### **Resource Conservation and Recovery Act and Solid Waste**

Car washes produce solid waste when the grit and associated sediments are pumped from the oil/water separator. The disposal of the grit and attendant materials is covered under the Resource Conservation and Recovery Act of 1976. The company which pumps the tank is usually the company which will take a necessary sample, ensure that chain of custody is documented properly, and forward the sample to a licensed laboratory for testing. Most pretreatment sludge collected from oil/water separators is non-hazardous as determined by the Toxicity Characteristic Rule under RCRA. The grit may not be properly disposed of unless its moisture content has been reduced. Under RCRA no waste can be a hazardous waste unless it is a solid waste (EPA, 2002).

### **Charity Car Washing Initiatives and Water Quality**

In some communities, notably, Kitsap County, Oregon, and San Antonio, Texas from 1996 to 2001, charity car washes have been discouraged or banned at any location other than a professional commercial car wash facility. In Kitsap County, Oregon, the Best Management Practice for car washing is explicitly designed to protect the watershed from stormwater impacts of detergents, oil and grease and grime entering the environment through runoff. Charity car washes in Kitsap County must use a professional facility, or capture their runoff with approved methods. The City of San Diego, CA is also explicit in its focus on stormwater protection. San Diego does not ban charity car washing, but does encourage use of professional car wash facilities in order to intercept runoff from the cars. The San Antonio Charity car wash program is a part of their Water Conservation Certification program and requires professional car washes that are certified as water conserving to host three charity carwashes each year. The concern with charity car washes on parking lots revolves both around the water waste, and contaminated water running

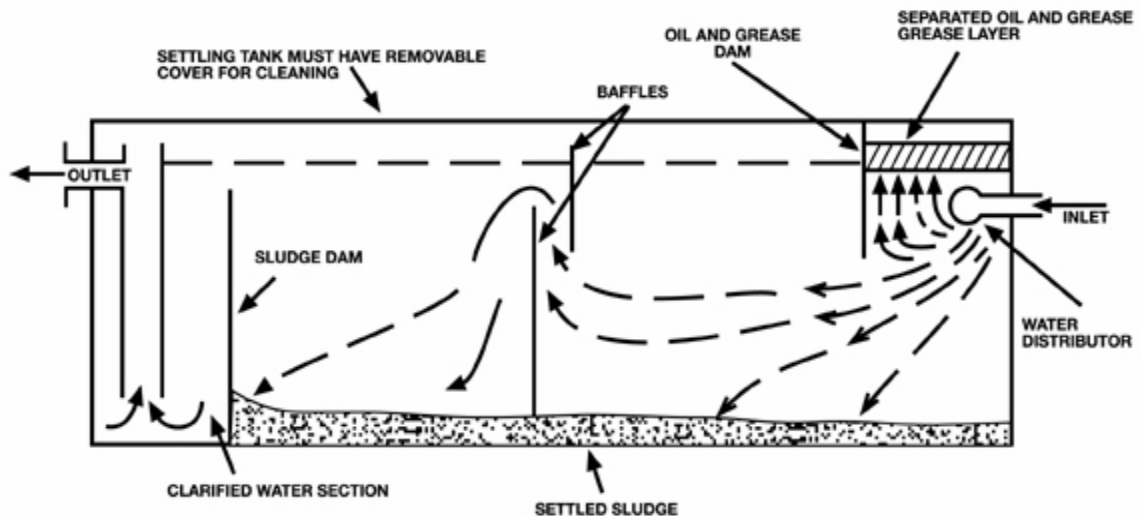


into the storm sewer system.

## METHODOLOGY

### Chemical Analysis

The methodology for water quality testing was designed to obtain samples that would be representative of the actual water quality discharged to the sewer from professional car washes. Pretreatment by oil & grease separators is often required for car washing facilities to remove free oil and grit from the waste stream prior to discharge to the sewer. In most cases in this study, pretreatment was in the form of a large tank with baffled compartments, in which oil was separated by capture in the initial compartment (See Diagram). A submerged orifice allowed water to flow to subsequent compartments. Grit also sinks to the bottom of the initial compartments of the tanks. In Phoenix and Orlando, where large tanks represented the common design, representative discharge samples were taken from the last compartment near the outfall to the sanitary sewer. In Boston some sites had initial tanks which acted as the primary grit and oil collector, and water flowed to a manhole before being discharged to the sanitary sewer. In these cases effluent samples were collected from the oil/water separator manhole located downstream of the car wash bays.



*Figure 1. Source: Water Conservation in the Professional Car Wash, International Carwash Association, Brown, C., 2000.*

### **Wastewater Sample Collection and Laboratory Analysis**

A composite sampler was used to gather the water quality samples. The ISCO 2910 Sampler was configured to take a sample hourly for a 24-hour sampling period. The intake for the sampler was placed at the discharge of the final compartment of the interceptor, approximately 1-2 feet below the water surface. Samples were collected and sent to an analytical testing laboratory and transported under appropriate conditions recommended by the laboratory to ensure accurate results. Each wastewater sample was designated as to type and location and was submitted to a licensed analytical laboratory and analyzed for the following:

- Total Suspended Solids (TSS);
- Settleable Solids (SS)
- Oil and Grease;
- Chemical Oxygen Demand (COD);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Clean Water Act 13 Priority Pollutant Metals;
- Sodium; and
- Chloride.

The results of the chemical analysis of the wastewater samples are summarized in Tables 2.1 to 2.3.

### **Grit Sample Collection and Laboratory Analysis**

In the Boston and Orlando sites, Oak Engineers collected a grab grit sample directly from the oil/water separator manhole located downstream of the car wash bays and dispensed the sample into laboratory-prepared glassware. Each grab grit sample was designated and was submitted to a licensed analytical laboratory and analyzed for the following:

- Total Solids;
- Oil and grease;
- COD;

- TKN;
- Total Phosphorus;
- Clean Water Act 13 Priority Pollutant Metals;
- Sodium; and
- Chloride.

The results of the chemical analysis of the grit sample are summarized in Tables 2.4 and 2.5.

### **Statistical analysis**

Analysis of variance (ANOVA) examines whether the apparent differences in observed data sets is more or less likely to have been caused by random chance. As the probability declines that the differences were random, confidence in the effect of differences rises. When ANOVA finds significant difference it is reported as being less than 0.05, 0.01 or 0.001 likely that the difference was caused by random chance. These values represent greater than 95%, 99% and 99.9% probabilities that the observed effects are caused by the geographic or climatic differences, the type of facility or the use of a reclaim system. This probability of random chance causing the observed effect is reported as  $p = 0.05$ , etc. A typical convention for reporting p values is to use an asterisk in place of the numbers, with the greater probability of an influence being reported with more asterisks, as  $0.05 = *$ ;  $0.01 = **$ ; and  $0.001 = ***$ . Differences in location, type of carwash or use of reclaim having made a difference in the results were examined for significance. The result of the ANOVA is found in the results and discussion section.

## RESULTS AND DISCUSSION

This section on water quality presents the mean water quality of waste wash water and grit for the conveyor, in-bay automatic washes, and self-serve car washes in three regions of the United States.

### Water Quality

The results of the water quality testing produced several non-detect values, particularly in regards to the 13 priority pollutants. The average value for sites with levels above minimum detection limits is presented along with the number of sites included in calculating the average. The non-detect value is reported using the procedure quantification limit (PQL) for each of the non-detect results. The PQL is the limit at which the testing procedure can detect a specific substance. In Table 2.1 to 2.5, if all sites were reported as non-detects, then the PQL is presented. The number of sites used in determining the mean value is presented for each facility type. Where all sites were non-detect, the PQL value is presented in parentheses.

Water quality analysis of the effluent was run on all thirty of the car washes examined in the 2000-2001 time frames. Water quality of effluent was evaluated in all three types of car washes in Boston and Orlando areas, and the self-serve and in-bays in the Phoenix area.<sup>1</sup> The mean values can be found in Tables 1 through 3 below. Analysis of variance was examined for facility type, the use of reclaim or the location for the EPA's thirteen priority metals, and a number of organic compounds and pollutants with characteristics, which would be of concern in car washes.

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<sup>1</sup> The earlier study of conveyors in Phoenix, which is reported in *Water Use in the Professional Car Wash Industry, 2002* did not evaluate water quality (Kobrick, 1997).  
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Tables 2.1 to 2.3 present the results of the wastewater quality testing for the self-service, in-bay automatic, and conveyor car washes by facility type. The water quality testing results for both washing methods are below the applicable regulatory limits for each pollutant. A comparison between the facility types results in comparable water quality results.

Intuition would suggest that self-service car washes would probably have greater levels of contaminants than in-bay automatics and conveyors due the lack of employees present and the tendency of much dirtier vehicles to be washed. This hypothesis was not born out by this study. However there was variation within locales based upon type. Each of the pollutants oil & grease and chemical oxygen demand (COD) in Phoenix and Boston was present in a higher concentration at the self-serve sites than at the in-bay automatic sites. This could be construed as a result of the fact that self-service facilities are unstaffed for many hours of the day, and customers may place many materials in the drains. However, a similar pattern was not found in Orlando, where self-service sites had the lowest measured quantities of oil & grease and COD in the effluent.

No significant differences in mean values were found for most of the constituents analyzed based upon geography. Two exceptions to this were oil & grease and zinc. Oil & grease was examined using the EPA method 1664, which looks at a total oil & grease, regardless of source. Oil & grease in a car wash could come from any of the petroleum products on the vehicle's surface or which might be leaking from the vehicle, or if any lubricants in equipment were leaking. All of the samples examined in all three locations fell at or below 100 ppm for oil & grease. Although levels of oil & grease and zinc were low, as seen in tables 2.1 to 2.3 and in figure 1, the differences in mean values was statistically significant ( $n = 30$ ,  $p = *$ ). Zinc is commonly found in paints and rubber products such as brake pads. Zinc levels in the effluent samples fell below 1.3 ppm. Boston had the highest levels of both of these contaminants at a mean value of 40 ppm oil & grease, and 0.8 ppm zinc for all sites.

Numerous contaminants were not detected by the laboratory analysis. They are listed as

PQL in the tables with a figure in parentheses. The figure is the lowest amount of the material that the analytical technique can detect. In cases where there were some sites with detectable amounts and others with non-detects, the non-detects were ignored for purpose of determining the mean. The number column for each type of facility has a fraction showing how many of the sites had values that were used in calculating the mean. Those sites not used in calculating the mean were below PQL. When all sites were below the procedural quantification limit, the PQL value is listed in the table. The heavy metals, beryllium, mercury, selenium and thallium were non-detects in all sites.

At one site in Boston, local discharge limits were exceeded by a sample that measured 20 mg/l. The discharge limit for that site at that time was 15mg/l. Currently the Massachusetts Water Resource Authority is in the process of modifying its limits. Under the proposed new rules, the 20mg/l sample would not exceed discharge limits (MWRA, 2002). None of the other sites exceeded discharge limits for any of the contaminants measured in the study.

**Table 2.1**  
**Phoenix Sites – Wastewater Quality<sup>2</sup>**

Parameter	In-bay Automatic		Self-Service Results	
	Number*	Mean	Number	Mean
Oil & Grease	1/3	8	3/3	30.9
Phosphorus	3/3	0.49	3/3	0.30
COD	3/3	158	3/3	423
Nitrogen as Ammonia	2/3	3.54	3/3	2.41
Nitrate plus Nitrite	1/3	0.2	3/3	PQL (0.1)**
Priority Metals				
Antimony	1/3	0.018	2/3	0.007
Arsenic	1/3	0.007	3/3	PQL (0.005)
Beryllium	3/3	PQL (0.002)	3/3	PQL (0.002)
Cadmium	1/3	0.005	1/3	0.006
Chromium	3/3	PQL (0.05)	2/3	0.006
Copper	2/3	0.119	3/3	0.095
Lead	2/3	0.016	3/3	0.016
Mercury	3/3	PQL (0.0005)	3/3	PQL (0.0005)
Nickel	3/3	PQL (0.02)	3/3	PQL (0.02)
Selenium	3/3	PQL (0.005)	3/3	PQL (0.005)
Silver	3/3	PQL (0.04)	1/3	0.07 (2)
Thallium	3/3	PQL (0.001)	3/3	PQL (0.001)
Zinc	3/3	0.31	3/3	0.36
Total Suspended	1/3	6	3/3	10
Settleable Solids	3/3	PQL (0.5)	3/3	PQL (0.5)

\*The Number column contains a fraction representing the total number of sites tested in the denominator, and the total number of sites that had values above the procedure quantification limit (PQL) in the numerator. The mean value is calculated using only the sites that were above the PQL.

\*\* The PQL is the limit at which the testing procedure can detect a specific substance. Numbers in parentheses indicate the lowest measurable quantity.

*All values in mg/l.*

<sup>2</sup> Laboratory analysis for Phoenix area sites was performed by Black & Veatch, 2850 E. Camelback Road, Suite 200 Phoenix, AZ 85016.



**Table 2.2**  
**Florida Sites - Wastewater Quality<sup>3</sup>**

Parameter	Self-serve		In-bay		Conveyor	
	Number	Mean	Number	Mean	Number	Mean
Oil & Grease	4/4	6.7	4/4	9.35	4/4	7.68
Total Khejldal Nitrogen	4/4	3.82	4/4	5.6	4/4	3.85
Total Phosphorous	4/4	1.487	4/4	9.79	4/4	6.41
Chemical Oxygen Demand	4/4	248.2	4/4	397.7	4/4	470
Priority Metals						
Antimony	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Arsenic	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Beryllium	4/4	PQL (0.01)	4/4	PQL (0.01)	4/4	PQL (0.01)
Cadmium	2/4	0.0075	4/4	PQL (0.01)	4/4	PQL (0.01)
Chromium	4/4	PQL (0.03)	4/4	PQL (0.03)	4/4	PQL (0.03)
Copper	3/4	0.11333	3/4	0.1467	2/4	0.235
Lead	4/4	PQL (0.04)	4/4	PQL (0.04)	4/4	PQL (0.04)
Mercury	4/4	PQL (0.0005)	4/4	PQL (0.0005)	4/4	PQL (0.0005)
Nickel	4/4	0.025	1/4	0.02	3/4	0.03
Selenium	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Silver	4/4	PQL (0.01)	4/4	PQL (0.01)	4/4	PQL (0.01)
Thallium	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Zinc	4/4	0.2775	4/4	0.2175	4/4	0.308
Sodium	4/4	602	4/4	302	4/4	43.3
Chloride	4/4	851	4/4	317	3/4	34
Total Suspended	4/4	27.25	4/4	35	4/4	37.5
Settleable solids	4/4	PQL (2)3	4/4	PQL (2)3	4/4	PQL (2)3

\*The Number column contains a fraction representing the total number of sites tested in the denominator, and the total number of sites that had values above the procedure quantification limit (PQL) in the numerator. The mean value is calculated using only the sites that were above the PQL.

\*\* The PQL is the limit at which the testing procedure can detect a specific substance. Numbers in parentheses indicate the lowest measurable quantity.

*All values in mg/l*

<sup>3</sup> Laboratory analysis for Florida sites was performed by Rhode Island Analytical Laboratory, 950 Boylston St., Newton Highlands, MA 02461.

**Table 2.3**  
**Boston Sites - Wastewater Quality<sup>4</sup>**

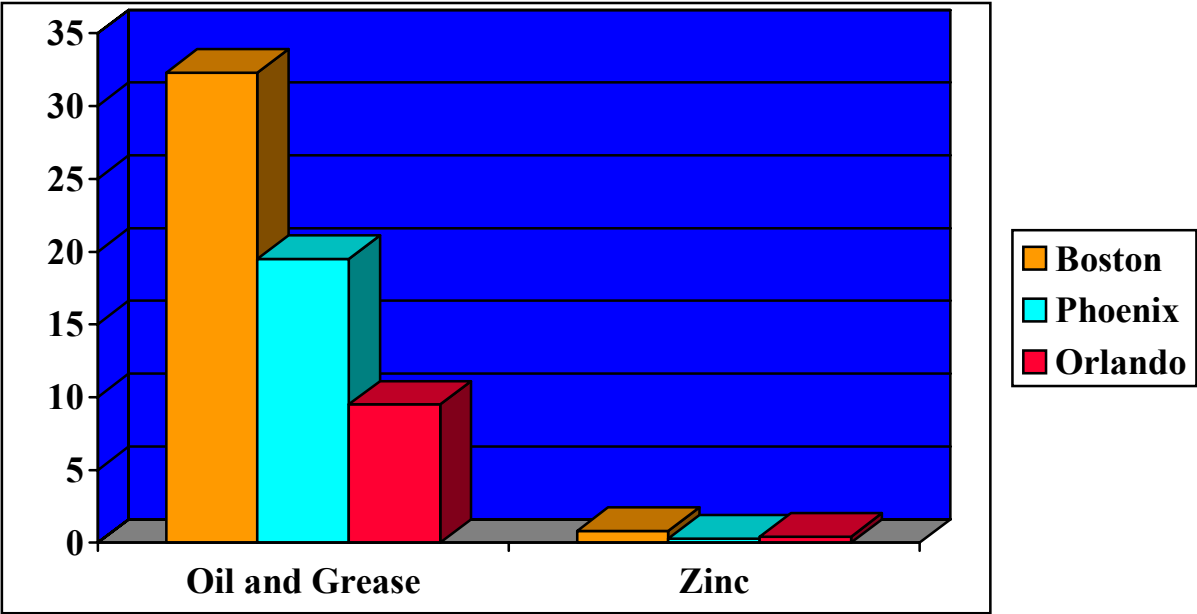
Parameter	Self-serve		In-bay		Conveyor	
	Number	Mean	Number	Mean	Number	Mean
Oil & grease	3/4	60	4/4	25	4/4	35
Total Khejldal Nitrogen	4/4	5.01	4/4	4.7	4/4	4.08
Total Phosphorous	3/4	0.87	4/4	12.08	4/4	2.403
Chemical Oxygen Demand	4/4	890	4/4	410	4/4	490
Priority Metals						
Antimony	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Arsenic	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Beryllium	4/4	PQL (0.01)	4/4	PQL (0.01)	4/4	PQL (0.01)
Cadmium	4/4	PQL (0.01)	4/4	PQL (0.01)	4/4	PQL (0.01)
Chromium	4/4	0.02425	4/4	0.0715	4/4	0.0688
Copper	4/4	0.2343	4/4	0.1475	4/4	0.1927
Lead	3/4	0.07033	3/4	0.06533	1/4	0.061
Mercury	4/4	PQL (0.0005)	4/4	PQL (0.0005)	4/4	PQL (0.0005)
Nickel	4/4	0.0365	3/4	0.0323	4/4	0.03025
Selenium	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Silver	4/4	PQL (0.01)	4/4	PQL (0.01)	4/4	PQL (0.01)
Thallium	4/4	PQL (0.1)	4/4	PQL (0.1)	4/4	PQL (0.1)
Zinc	4/4	0.979	4/4	0.73	4/4	0.6772
Sodium	4/4	125	4/4	137.2	4/4	102.1
Chloride	4/4	110	4/4	52.95	3/4	108.3
Total suspended	4/4	117.3	4/4	34	3/4	35
Settleable solids	4/4	PQL (2)3	4/4	PQL (2)3	4/4	PQL (2)3

<sup>4</sup>The Number column contains a fraction representing the total number of sites tested in the denominator, and the total number of sites that had values above the procedure quantification limit (PQL) in the numerator. The mean value is calculated using only the sites that were above the PQL.

\*\* The PQL is the limit at which the testing procedure can detect a specific substance. Numbers in parentheses indicate the lowest measurable quantity.

*All values in mg/l*

Figure 2.1  
Comparison for Two Parameters by Location



## Grit Results

The grit results are reported as dry weight of contaminant in mg/kg in Tables 2.4 and 2.5 for Boston and Orlando respectively. The Phoenix study did not include grit analysis. A number of the grit parameters showed significant difference based upon location and by use of reclaim when ANOVAs were run. Mean values, standard deviation and level of significance for the parameters, which varied by location and use of reclaim, are reported in Tables 2.6 and 2.7. Analysis of variance also showed that there was no significant difference in the levels of pollutants found in grit based upon the type of car wash.

There was variation based upon location and use of reclaim for several parameters. Percent solids varied by region (Boston =  $54.3 \pm 16.0$ ; Florida =  $35.0 \pm 19.7$ ;  $n = 24$ ,  $p = *$ ), which could have an impact on the results as they are reported as dry weight (laboratory value/percent solids). The total volume of grit entrained in the traps could impact these measurements, as samplers were lowered through the water in the oil/water separators into the grit. Different soil types could also contribute to these differences with larger pore space in Florida. However, a soil analysis was not performed as a part of this study.

Other parameters that varied by location included copper, and oil & grease. Analysis of variance showed that only oil & grease in the grit varied based upon the use of reclaim. Table 2.6 shows the mean, standard deviation, number of samples that were above the PQL by location. Analysis of variance indicated that the observed differences between other parameters by location were not statistically significant.

Since most of the entrained grit in a car wash will be native soil washed off vehicles, the overall values of the metals found in the grit would be expected to be within the range of local soil values. A couple of the metals exceeded expected concentrations. Copper was found in levels exceeding those typically found in soils (2 - 200 ppm) in all of the Florida categories, and in the self-service facilities in the Boston area. Zinc exceeded background levels expected from soils (10 - 300 ppm) in all but the in-bay automatic category in Boston area sites.

These elevated concentrations could indicate that cleaning solution or purified rinse water was interacting with metals in the car wash equipment, if copper or galvanized pipes were used. Zinc can also be found in the rubber in brake pads.

Oil & Grease was significantly higher in the Orlando in-bay Automatics and conveyor categories than in the Orlando self-service facilities. However, in Boston the in-bay sites had the lowest mean values for oil & grease. These results indicate that differences in car wash type are not the determinant in the variation that was observed. The age of equipment, type and concentration of cleaning solutions, size of separation tanks, and time since last emptied could all have contributed to the differences observed in the various types of car washes.

Carwashes with reclaim systems averaged higher concentrations of oil & grease than those without. Oil & grease quantities in the grit in reclaim systems were  $120,448 \pm 91,247$  mg/kg, as compared with those without reclaim systems at  $50,525 \pm 44,472$  mg/kg ( $n = 24$ ,  $p = *$ ). The use of reclaim systems in the in-bay automatics and conveyors with re-circulating water may have contributed to binding of oil & grease to soil particles rather than floating at the top of the separator baffle.

Regressions were run on the contaminants found in the grit samples and in the wastewater to determine if there was a relationship between the amount of a particular pollutant in the grit and the same material in the effluent. No significant relationships were found. This indicates that the oil/water separators in these sites were working well as pretreatment systems by containing the pollutants in the trap.

In the Boston samples, mean values of lead exceeded the federal regulatory standards for the self-service and conveyor sites, while in-bay sites fell below the standard. All of the conveyor and self-service sites tested exceeded the 100mg/kg limit for hazardous waste designation for lead. In the Florida samples, the mean values for lead in the grit exceeded the standards for all three types of facilities. This was caused by seven of the twelve sites exceeding the standard. Current regulatory requirements are driven by the local disposal facility, and focus on the potential for the

contaminant to leach from the disposal site. If these grit samples had been intended for disposal, for those samples which showed high lead quantities, a toxic characteristic leaching potential (TCLP) test would be run to determine if the material is bound to the grit or if it would be likely to leach into groundwater or surface water near the disposal site. If the TCLP readings on lead were below 5 mg/kg then the material would be classified as non-hazardous waste. TCLPs were not run on these grit samples.

**Table 2.4  
Boston Grit**

Parameter	Self-serve		In-bay		Conveyor	
	Number	Mean	Number	Mean	Number	Mean
Oil & grease	4/4	53,250	4/4	7,712	4/4	63,125
Total Khejldal Nitrogen	4/4	PQL (6,250)	4/4	PQL (6,250)	4/4	PQL (6,250)
Total Phosphorous	3/4	774	4/4	153.8	3/4	274
Chemical Oxygen Demand	4/4	9,750	4/4	2,072	4/4	7,325
Priority Metals						
Antimony	4/4	PQL (5)	4/4	PQL (5)	4/4	PQL (5)
Arsenic	1/4	20.4	4/4	PQL (5)	4/4	PQL (5)
Beryllium	4/4	PQL (0.5)	4/4	PQL (0.5)	4/4	PQL (0.5)
Cadmium	3/4	7.37	1/4	1.28	3/4	2.93
Chromium	4/4	80.4	4/4	47.5	4/4	141.7
Copper	4/4	510	4/4	125.1	4/4	408
Lead	4/4	225	4/4	47.5	4/4	190
Mercury	4/4	1.37	4/4	PQL (0.25)	3/4	23.8
Nickel	4/4	50	4/4	12.65	4/4	42.7
Selenium	4/4	PQL (5)	4/4	PQL (5)	4/4	PQL (5)
Silver	4/4	PQL (0.5)	4/4	PQL (0.5)	4/4	PQL (0.5)
Thallium	4/4	PQL (5)	4/4	PQL (5)	4/4	PQL (5)
Zinc	4/4	810	4/4	250	3/4	825
Sodium	4/4	1,062	2/4	175	2/4	435
Chloride	1/4	8,300	1/4	350	4/4	PQL
Percent Solids	4/4	42.6	4/4	70.8	4/4	49.5

\*The Number column contains a fraction representing the total number of sites tested in the denominator, and the total number of sites that had values above the procedure quantification limit (PQL) in the numerator. The mean value is calculated using only the sites that were above the PQL.

\*\* The PQL is the limit at which the testing procedure can detect a specific substance. Numbers in parentheses indicate the lowest measurable quantity.

*All values in mg/kg*

**Table 2.5  
Florida Grit**

Parameter	Self-serve		In-bay		Conveyor	
	Number	Mean	Number	Mean	Number	Mean
Oil & Grease	4/4	64,250	4/4	122,100	4/4	185,000
Total Khejldal Nitrogen	4/4	2,568	4/4	5,244	4/4	3,947
Total Phosphorous	4/4	140	4/4	935	4/4	1,458
Chemical Oxygen Demand	4/4	2,250	4/4	3,623	4/4	19,315
Priority Metals						
Antimony	4/4	42.22	4/4	156.8	4/4	193.1
Arsenic	4/4	7.9	4/4	15.5	3/4	19.3
Beryllium	4/4	0.1275	3/4	0.28	2/4	0.295
Cadmium	4/4	5.5	4/4	31.7	4/4	10.91
Chromium	4/4	43.8	4/4	94.8	4/4	101.3
Copper	4/4	334.7	4/4	1307	4/4	1189
Lead	4/4	101.1	4/4	184.3	4/4	119.4
Mercury	4/4	PQL (0.25)	4/4	PQL (0.25)	4/4	PQL (0.25)
Nickel	4/4	44.2	4/4	101.6	4/4	63.7
Selenium	4/4	PQL (5)	4/4	PQL (5)	4/4	PQL (5)
Silver	4/4	PQL (0.5)	4/4	PQL (0.5)	1/4	3.57
Thallium	4/4	PQL (5)	4/4	PQL (5)	4/4	PQL (5)
Zinc	4/4	601.3	4/4	2,024	4/4	1,591
Sodium	4/4	1,167	4/4	1,128	2/4	1,216
Chloride	2/4	3,300	2/4	2,000	4/4	PQL
Percent Solids	4/4	49.4	4/4	32.1	4/4	23.4

\*The Number column contains a fraction representing the total number of sites tested in the denominator, and the total number of sites that had values above the procedure quantification limit (PQL) in the numerator. The mean value is calculated using only the sites that were above the PQL.

\*\* The PQL is the limit at which the testing procedure can detect a specific substance. Numbers in parentheses indicate the lowest measurable quantity.

*All values in mg/kg*



**Table 2.6  
Grit Analysis of Variance by Location**

Parameter <sup>1</sup>	Boston		Florida		Significance <sup>3</sup>	
	Number	Mean	Standard Deviation	Mean		Standard Deviation
Percent Solids <sup>2</sup>	24	54.3	16	35	19.7	*
Oil & Grease	24	41362	41755	123783	83224	**
Copper	24	347.5	260	943.6	937.5	*

<sup>1</sup>Differences between all other parameters measured were not significant based upon location, or car wash type.

<sup>2</sup>Percent Solids are in percent by weight, all other measurements are in ppm.

<sup>3</sup>Significance is represented by \* for p=0.05, \*\* for p=0.01, and \*\*\* for p=0.001.

## **Conclusions**

As with earlier studies by the EPA, the data collected in this study indicates that the oil/water separator tanks in professional car washes perform pretreatment of the effluent as expected. With regular maintenance and cleaning of the accumulated grit, the car wash operator can expect the oil/water separator tank to perform adequate pretreatment.

This study found that very low levels of contaminants were found in the effluent discharged from the professional car washes to the local POTW. For several of the contaminants measured, including beryllium, selenium, silver, and thallium, no measurable quantities were detected. Individual operators need to be aware of and remain in compliance with discharge limits per their local POTW and local or state regulations.

The low levels of pollutants found in the effluent of professional car washes, and the fact that 99% of them discharge to publicly owned treatment works, is consistent with those communities which view vehicle washing in a professional facility as a significant contribution to water quality in their NPDES programs. Contaminants caught in the grit are also prevented from entering surface and groundwater through stormwater flows. The professional car wash, by routing effluent to the POTW removes potential non-point source pollutants from the stormwater of the community. While this study did not specifically focus on the impact to total maximum daily loads, the results suggest that the capture of car wash effluent and solids contributes to reducing non-point source pollution.

The contaminants found were all intercepted and removed from the waste stream prior to discharge. This contribution to water quality may be favorably compared to home and charity car washing on a driveway or parking lot where neither oil & grease, nor suspended solids are intercepted. Unless home and charity car washing is performed on a pervious surface, contaminants suspended upon the surface of the cars can be assumed to be entering the stormwater systems, and thus into local surface- or ground-waters. The grit trap data in this study, while not directly focused upon charity or home car washing, supported the assumptions inherent in efforts of Kitsap County, the City of San Diego and others who have banned or

discouraged charity car washing without appropriate capture of runoff. The results of this study regarding contaminants in grit indicate that significant levels of some contaminants are caught in the grit by the oil/water separation tanks in professional car washes.

This study was the first to characterize contaminants in oil/water separator grit from car washes on a dry weight basis. Some of the unanticipated variation in the samples may be explained by further studies that focus upon details which were not part of the scope of this study. Equipment age, and materials, cleaning solution properties, size and dimensions of separator tanks could all have contributed to the variation found in grit samples.

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