Best Management Practices for Commercial Car Washes

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Contents

Executive Summary

I searched Google and Scopus to compile the information included in these results. I used the following search strategies:

- "commercial car wash" "best management practices" "chemicals"
- "commercial car wash" "best management practices" water
- "commercial car wash" "best management practices" energy
- Car wash chemicals (Scopus)

Most of the information that I located relates to a water management/efficiency/treatment. I also found some useful material related to chemicals used in commercial car washes, as well as safer alternatives. Much of the health and safety information that I located dealt with hand washing, rather than automatic systems. I was unable to locate energy efficiency BMPs specifically for commercial car washes.

Overview of environmental impact

There are three common types of professional car wash systems:

- In a conveyor car wash system, the car moves on a conveyor belt while the exterior of the car is washed. Conveyer wash systems can use friction or frictionless technology. The friction wash uses brushes or curtain strips made of cloth or other material to clean the vehicle, while the frictionless uses high-pressure nozzles. The conveyor car wash is either full service or exterior only. In a full-service conveyor car wash, both the interior and exterior of the car are cleaned. Exterior-only car washes do not clean the interior.
- At an in-bay automatic car wash, the vehicle is parked in a bay and remains stationary while a machine moves back and forth over the vehicle to clean it. A professional in-bay car wash uses brushes made of nylon or other material, soft cloth strips, or automatic washers consisting of high pressure nozzles.
- In a self-service car wash, the customers wash the vehicles. A wand dispenses water and cleanser at varying amounts and pressures. In addition, a low-pressure brush may be available to assist in the wash cycle.

Wash wastewater from professional car wash systems can have a great impact on the environment if not properly managed and discharged. Contaminants include:

- Oil and grease, which contain hazardous materials such as benzene, lead, zinc, chromium, arsenic, pesticides, herbicides, nitrates, and other metals
- Detergents, including biodegradable detergents, that can be poisonous to fish
- Phosphates, which are plant nutrients and can cause excessive growth of nuisance plants in water bodies

- Chemicals, such as hydrofluoric acid and ammonium bifluoride products (ABF), and solvent-based solutions that are harmful to living organisms
- Chemicals and oils used for the maintenance of cleaning machinery (for automatic systems)
- Debris that can clog storm sewer inlets and grates and thereby prevent storm water drainage to the sewer

Washing vehicles on hard, impervious surfaces such as concrete areas can cause wash wastewater flow into storm drains. Car wash wastewater can be harmful to humans, plants, and animals if released untreated to surface water bodies. Additionally, allowing wash wastewater to soak into the ground can be harmful because the wastewater may contaminate soil and groundwater.

Resources

Environmental Rules for Car Washes (Texas Department of Environmental Quality)
http://www.gptx.org/home/showdocument?id=2665

International Car Wash Association
http://www.carwash.org/
Trade association for the retail and supply segments of the professional car wash industry. Includes extensive information for operators, including a supplier guide.

Car Wash Magazine
http://www.carwash.org/get-connected/car-wash-magazine
Published by the International Car Wash Association

Professional Car Washing and Detailing
http://www.carwash.com/
Trade magazine and blog for the professional car wash industry. Web site includes categories for environmental issues and chemicals.

Water use/conservation/treatment

Fact sheets and non-technical information

Evaluation of Potential Best Management Practices – Vehicle Wash Systems (California Urban Water Conservation Council, 2006)
https://cuwcc.org/Portals/0/FINAL%20Carwash%2010-15-10.pdf

Guide to Best Management Practices: 100% Closed-Loop Recycle Systems at Vehicle and Other Equipment Wash Facilities (Florida Department of Environmental Protection, 2005).
http://www.dep.state.fl.us/water/wastewater/docs/GuideBMPClosed-LoopRecycleSystems.pdf

How Do I Handle My Professional Car Wash Wastewater? (Illinois EPA, 2015).
http://www.epa.illinois.gov/topics/small-business/publications/car-wash/

WaterSavers
http://www.carwash.org/for-operators/watersavers
A recognition program from the International Carwash Association designed to help professional car washes promote their environmentally responsible business practices. The consumer web site for the program (http://www.carwash.org/watersavers) includes a directory of car washes that participate in the program. The directory can be helpful for identifying businesses that might be able to answer specific questions about environmentally preferable products and practices.

Water Conservation in the Professional Car Wash Industry (International Carwash Association, 200?)
http://www.carwash.org/docs/default-source/watersavers-pdfs/water-conservation-in-the-professional-car-wash-industry.pdf

Water Use in the Professional Car Wash Industry (International Carwash Association, 2002).
http://www.carwash.org/docs/default-source/watersavers-pdfs/water-use-in-the-professional-car-wash-industry.pdf?sfvrsn=4

Vehicle and Equipment Washwater Discharges: Best Management Practices Manual (Washington State Department of Ecology, 2012)
https://fortress.wa.gov/ecy/publications/publications/95056.pdf

Research articles

Abelmoez, W.; Barakat, N.A.M.; Moaz, A. (2013) "Treatment of wastewater contaminated with detergents and mineral oils using effective and scalable technology." Water Science & Technology 68(50) 974-981. http://dx.doi.org/10.2166/wst.2013.275.

Abstract: In this work, effective, cheap and scalable methodology is introduced to treat oily wastewater. The water produced from car-wash processes was utilized as a model because it has various pollutants – oil, lubricants, detergents, solid particles, etc. The results showed that the turbidity and chemical oxygen demand (COD) values dramatically decrease by using the proposed treatment process, which consists of coagulation, flocculation, sand filtration, and oxidation followed by sand as well as activated carbon filtration. Moreover, the operating conditions were optimized. Without adjustment of the pH value of car-wash wastewater, it was found that 200 ppm of ferric chloride, as a coagulant, and 1 ppm of potassium permanganate, as an oxidant, are the optimum doses. The COD and turbidity values of the final treated wastewater were reduced by almost 88 and 100%, respectively. A prototype with 15 L capacity was designed and fabricated to investigate the scaling up and continuity of the proposed treatment strategy. The results were very promising and indicated that the introduced methodology can be industrially applied.

Bakacs, M., Yergeau, S., and Obropta, C. (2013). "Assessment of Car Wash Runoff Treatment Using Bioretention Mesocosms." *J. Environ. Eng.*, 10.1061/(ASCE)EE.1943-7870.0000719, 1132-1136. http://dx.doi.org/10.1061/(ASCE)EE.1943-7870.0000719

Abstract: Car wash runoff is known to be a pollution source to surface water bodies. Many groups hold car-washing fundraisers unaware of pollution issues associated with car wash runoff. This preliminary study investigated whether rain gardens are an appropriate management practice for reducing car wash pollutants, specifically surfactants. The concentrations of total phosphorus (TP), total suspended solids (TSS), and surfactants were measured in car wash runoff before and after treatment in three rain garden mesocosms. Mean TSS and surfactant effluent concentrations were significantly lower than the car wash runoff with TSS reductions ranging from 84 to 95% and surfactant reductions ranging from 89 to 96%. The removal efficiencies for surfactants were not enough to reduce concentrations below literature-based values for aquatic toxicity. Mean TP effluent concentrations were higher than the car wash runoff with increases ranging from 197 to 388%, although the increase was not statistically significant. This project demonstrates the potential for using bioretention to reduce pollutants associated with car wash runoff and using car wash events to educate the public about watershed protection.

El-Ashtoukhy, E-S. Z.; Amin, N.K.; Fouad, Y.O. (2015). "Treatment of real wastewater produced from Mobil car wash station using electrocoagulation technique." Environmental Monitoring and Assessment 187:628. http://dx.doi.org/10.1007/s10661-015-4836-4

Abstract: This paper deals with the electrocoagulation of real wastewater produced from a car wash station using a new cell design featuring a horizontal spiral anode placed above a horizontal disc cathode. The study dealt with the chemical oxygen demand (COD) reduction and turbidity removal using electrodes in a batch mode. Various operating parameters such as current density, initial pH, NaCl concentration, temperature, and electrode material were examined to optimize the performance of the process. Also, characterization of sludge formed during electrocoagulation was carried out. The results indicated that the COD reduction and turbidity removal increase with increasing the current density and NaCl concentration; pH from 7 to 8 was found to be optimum for treating the wastewater. Temperature was found to have an insignificant effect on the process. Aluminum was superior to iron as a sacrificial electrode material in treating car wash wastewater. Energy consumption based on COD reduction ranged from 2.32 to 15.1 kWh/kg COD removed depending on the operating conditions. Finally, the sludge produced during electrocoagulation using aluminum electrodes was characterized by scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS) analysis.

Obropta, C.C.; Bakacs, M.E.; Rector, P. (2016). "Rainwater Harvesting at the Department of Public Works." Journal of Extension 54(1), 1IAW6. https://joe.org/joe/2016february/iw6.php

Abstract: As part of an urban Extension initiative that focuses on reducing storm water runoff from impervious surfaces, Rutgers Cooperative Extension installed 5,000-gal cisterns at the Department of Public Works (DPW) facilities in Clark Township and the Township of Parsippany-

Troy Hills, New Jersey, to harvest rainwater from the rooftops of the garages at these facilities. This project intercepts rooftop runoff before it can carry nonpoint source pollutants from the land surrounding the DPW garages. The harvested rainwater is used to fill street sweepers, wash municipal vehicles, and supply water for a "green car wash" to support volunteer groups.

Zaneti, R; Etchepare, R.; Rubio, J. (2011). "Car wash wastewater reclamation. Full-scale application and upcoming features." *Resources, Conservation and Recycling* 55(11), 953-959. http://dx.doi.org/10.1016/j.resconrec.2011.05.002

Abstract: Recent features on car wash wastewater reclamation and results obtained in a full-scale car wash wastewater treatment and recycling are reported. The technique employed comprises a new flocculation-column flotation (FCF), sand filtration and final chlorination. Water usage and savings audits (20 weeks) showed that almost 70% reclamation was possible, and less than 40 L of fresh water per wash was attained. Wastewater and reclaimed water were fully characterized by monitoring chemical, physicochemical and biological parameters. Results were discussed in terms of reclamation aesthetic quality (water clarification and odour), health (pathological) and chemical (corrosion and scaling) risks. Noteworthy, this work showed a high count of fecal and total coliforms both in the wastewater and in the treated water, making the need of a final disinfection mandatory. The cost-benefit analysis shows that, for a car wash wastewater reclamation system in Brazil, at least 8 months were needed for the FCF-SC equipment amortization, when considering a demand over 30 washes per day. It is believed that the discussions on car wash wastewater reclamation criteria may assist alerting wash cars units and institutions to create laws in Brazil and elsewhere.

Chemical use and safer alternatives

Genuino, H.C.; Opembe, N.N.; Njagi, E.C.; McClain, S.; Suib, S.I. (2012). "A review of hydrofluoric acid and its use in the car wash industry." *Journal of Industrial and Engineering Chemistry* 18(5), 1529-1539. http://www.carwash.org/docs/default-source/safety-resources/hf-study.pdf?sfvrsn=2

Abstract: Hydrofluoric acid (HF) is a common ingredient in car wash cleaning solutions mainly because it is highly effective and relatively inexpensive. Particulate matter from brake pads and discs, tire wear, and abrasion of road surface accumulated on the exterior of automobiles are aggressively removed with the use of car wash cleaning solutions containing HF. The unique properties of HF to dissolve silica, concrete, most metals, and metallic oxides cause effective breakdown of rust, road dust, and grime on automobiles. However, HF is a very caustic and a highly toxic substance. Due to hazards associated with the storage, use, and exposure of HF to humans and the environment, there is a need to find safe, yet equally effective alternatives to HF as a cleaning agent. Improvements in cleaning processes, development of available technologies, and utilization of cleaning products containing natural and various benign polymers and surfactants are healthy and environmentally sound alternatives to HF for car wash applications. However, these alternatives may not be as effective as HF. Efforts geared towards finding a

replacement for HF remain a challenge, but the outcome would render several benefits to the car wash industry, including abating pollution and providing a safer working environment for everyone.

"Occupational Hydrofluoric Acid Injury from Car and Truck Washing — Washington State, 2001–2013." *Morbidity and Mortality Weekly Report* 64(32), 874-877.
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6432a4.htm

Abstract: Exposure to hydrofluoric acid (HF) causes corrosive chemical burns and potentially fatal systemic toxicity. Car and truck wash cleaning products, rust removers, and aluminum brighteners often contain HF because it is efficient in breaking down roadway matter. The death of a truck wash worker from ingestion of an HF-based wash product and 48 occupational HF burn cases associated with car and truck washing in Washington State during 2001–2013 are summarized in this report. Among seven hospitalized workers, two required surgery, and all but one worker returned to the job. Among 48 injured workers, job titles were primarily auto detailer, car wash worker, truck wash worker, and truck driver. Because HF exposure can result in potentially severe health outcomes, efforts to identify less hazardous alternatives to HF-based industrial wash products are warranted.

Car wheel cleaner based on alcohol ethoxylates and dodecyldimethylamine oxide as alternative to fluorine containing products (SUBSPORT)
http://www.subsport.eu/case-stories/317-en
Some car cleaning workshops use ammonium bifluoride or even hydrofluoric acid to remove fast and efficiently dirt from wheels. Both substances are hazardous. Al alternative product with dodecyldimethylamine oxide, alcohol ethoxylates as main ingredients is available as a less hazardous solution.

U.S. EPA Safer Choice Products
https://www.epa.gov/saferchoice/products

To filter for car wash products, select Business and Car Care Products from the appropriate drop-dpwn menus.