

REMOVAL OF IMPORTANT PARAMETER FROM CAR WASH WASTEWATER - A REVIEW

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Keywords: chemical oxygen demand, oil and grease, surfactant

Abstract. Huge quantity of water consumed per car and the various chemical agents used in car wash activities discharged the untreated effluents into the stormwater system and eventually ending up in our lakes, rivers and oceans [1]. The accumulated sediments from vehicle wash contain contaminants that reach concentrations where the sludge is considered as a controlled or hazardous waste, including of metals, elevated levels of oil and grease, and the unacceptable levels of acidity or alkalinity [2]. This paper provides a comprehensive review of car wash wastewater data analyzes regarding the wastewater discharges, as well as contaminant levels of car wash activities. Besides, the further extensive research on treatments used in the car wash industry for pollutant removal routes, including the removal efficiency of pollutants has also been highlighted. The expansion of the review on the influence of the treatment indicates that, the efficiency on removal pollutants depends on the treatment used. Overall, the review illustrates the necessity of a profound knowledge on the car wash wastewater with an extensive list of common treatment of car wash wastewater in providing the alternative way for on-site treatment for car wash outlet in treating the effluent before discharging into water bodies. Hence, decreases the pollution governing environmental, operational parameters, and the treatment performances of low cost system in treating the car wash wastewater.

1.0 Introduction

In this worldwide, about 20 million hectares of land are occupied with treated and untreated wastewater use. Malaysia has their own environmental quality regulations, but seldom enforced to the car wash industry [3]. The car wash discharge system cannot mix with the stormwater system, where it can contribute to the permeation of other pollutants towards the aquatic animals [9,17]. A car wash is defined as a non-domestic installation for external cleaning of cars, offering consumers a practical way to wash dirt from their automobiles [3,4]. The Environmental Pollution Agency rose awareness of the following list from vehicle washes such as detergents, heavy metals, oil, grease, polycyclic aromatic hydrocarbons (PAH's) and volatile organic compounds (VOC's) [3,12,14]. Oil and grease contain toxic substances which are carcinogenic to human beings whereas, the accumulation of heavy metals concentrations reducing microbial activity, lead to the inhibition of chlorophyll synthesis which hazard to the ecosystem [12,18,19]. Moreover, the synthetic anionic surfactants, commonly linear alkyl sulphate (LAS) and sodium dodecyl sulphate (SDS) components from detergent of car wash activities are very slow to biodegrade into the environment, lowering the oxygenation potential and hence, kills the waterborne organisms [8]. Hence, the concentration and severity each element should be assessed and considered in treating the pollutants. In this review, an extensive lists of treatment for car wash wastewater from conventional methods has been compiled and discussed. The efficiency of each system in removing pollutants were analyzed and compared.

2.1 Car wash wastewater treatment

2.1.1 Ultrafiltration (UF) and nanofiltration (NF) membrane

Generally, the membrane technologies commonly used in wastewater treatment, including of UF and NF membrane [12]. With the aid of the UF membrane, the biodegradable organics, colloids and some viruses can be removed as presented in Table 1. UF membrane and NF membrane have different performances in treating wastewater [10,13,15,18]. The oil emulsion are the main pollutant observed in car wash wastewater, commonly by the detection of PAH's in lubricant oils. A study reported the oil emulsion was not absorbed directly to the NF membrane due to the negative charge repulsion between anionic emulsion and membrane surface, where the NF membrane removing 98% of pollutants of total organic carbon compared to UF membrane [15]. The UF membrane is ineffective in removing conductivity and total dissolved solids removal, because the membrane has flux deterioration and low flux recovery rate [14]. Apart from using the UF and NF membrane itself, the performance of hybrid system combining the bio-carriers and non-woven membrane filtration was explored. Rather than the UF membrane, the non-woven material of the membrane separating the suspended solid at lower operating pressure and reasonable cost. The bio-carriers have large porous structures of surfaces allowed it to trap the attached growth microorganisms and then degrading the biodegradable matter, and removing the organic removal of car wash wastewater [13].

Table 1: Car wash wastewater treatment systems

No	Type of treatment	Results			Reference
			Parameter	Percentage removal (%)	
1	Membranes	Ultrafiltration membrane	TOC		15
		PS-100		75	
		C-100		75	
		C-30		75	
		GM		75	
		Nanofiltration membrane			
		DK		98	13
		Ultrafiltration membrane	COD		
		PVDF 100		56.1 - 82.4	
		PES 30		54.9 - 83.9	
		Nanofiltration membrane			
		NF 270		70.9 - 91.5	
		Ultrafiltration membrane	TDS	82.2	18
			TSS	81.08	
			COD	67.5	
			O&G	74.97	
2	Oil separator	Gravity oil separator	COD	70.15	10
			SS	95.65	
			O&G	80	8
			TSS	88	
			VSS	87	
			TDS	40	
			VDS	46	
			COD	74	
		Oil separator	O&G	73-98.47	2
3	Chemical oxidation by aeration, alum (80 mg/L), waste hydrogen peroxide (2.5 ml/L)		O&G	96	3
			COD	93	
			TDS	74	
			pH	14	
			Conductivity	26	
			Turbidity	94	
			DO	78	
			TS	91	

Table 1 continued

4	Flocculation column flotation, sand filtration and final chlorination			TSS	91	21
				Turbidity	91	
				TC	95	
				E. Coli	99	
5	Hydrophilic and hydrophobic membrane	Hydrophilic membrane	Surfactant	Nonionic	93 - 99	4
		NF270		Cationic	83 - 99	
				Anionic	85 - 100	
				COD	78 - 98	
		Hydrophobic membrane		Nonionic	30 - 91	
		NFPES 10		Cationic	27 - 71	
				Anionic	53 - 100	
				COD	33 - 78	

2.1.2 Oil separator

The oil separator was designed to ensure the removal of all light oils escaped from the oil skimmer in the settling tank. In this study, the authors suggested the treated water from the study can be used for wash and pre rinse for the car washes [2]. Besides, the conventional oil separator has less of specific standards recommended for the design of gravity separators for car wash stations. Based on the performance of the gravity oil separators observed in the car wash industries, the authors concluded the system does not allow producing an effluent that complies with the discharge limits established in the sewage system. The removal of oil and grease (O&G), total suspended solid (TSS), volatile suspended solid (VSS), total dissolved solid (TDS), and chemical oxygen demand (COD) exhibited better results of removal by using gravity oil separators. However, the results of chemical oxygen demand and total suspended solid were not followed the sewer discharge standards [8].

2.1.3 Chemical oxidation

The chemical oxidation including process of aeration for oil water separation, alum treatment for pollutant removal with aid of hydrogen peroxide. The aeration responsible to separate the oil and water by trapping the oil by the air bubbles carrying oxygen. Total chemical oxygen demand reduction after going through the overall processes was 93%. The increase dosage of alum alone for the treatment does not meet the desired discharge standard. The aid of hydrogen peroxide creates positively charged and polynuclear species, resulting charged compounds react with colloids attained with negative ions present in the wastewater. The gravity force helps in removing of suspended solids and chemical oxygen demand. Moreover, the alum act as a coagulant whereas the hydrogen peroxide reducing the concentration of chemical oxygen demand from car wash wastewater. The further treatment by waste hydrogen peroxide were done subsequently after the aeration and addition of alum processes. The present study has potential to reduce the cost of water treatment and requires less space without any pH control [3].

2.1.4 Flocculation column flotation (FCF), sand filtration (SF) and final chlorination (FC)

Flocculation allows the removal of organic matters and colours of wastewater. However, the treatment should be furthered studied with the other processes, depends on the proper selection of flocculant and proper designed of system to improve the operations [16]. Treatment of car wash wastewater by flocculation column flotation experimented in Brazil. However, the results obtained were high for turbidity and colour due to the existence of bubbles, the presence low surface tension and oil and grease which yielding the light flocs [19]. Another study in 2013 have combined a bench study of FCF and SF followed by a FC for car wash wastewater treatment. The SF process helps in removing the pathogenic microorganisms from car wash wastewater and the process of

chlorination inhibit the growth of E. Coli. The last stage of treatment, final chlorination helps in removing the pathogens and other microorganisms that may have passed by SF. During the process, the chlorine disinfection deactivated the microorganism lives resulting death of different mechanisms. As the results, the coupled system of the treatment effective with removal of E. Coli, TSS, turbidity, TOC were 99%, 91%, 91% and 95% respectively [21].

2.1.5 Hydrophilic and hydrophobic membrane

The hydrophilic and hydrophobic membrane has a high water permeability with different surfactants and the membrane fouling have been studied. The results show that the hydrophilic membrane was more efficient in removing different type of surfactants compared with hydrophobic membrane. Hydrophilic membrane was not damaged after undergoing the treatment of car washes. Moreover, there was no chemical needed to enhance the membrane flux of the membrane. The authors have concluded that the nanofiltration membrane can also be used for recycling wastewater [4].

3.0 Conclusions

There was lack information regarding the treatment used for car wash wastewater treatment system. In spite of using conventional methods and simple treatment strategies for car wash wastewater treatment system, a wide range of any low cost potential wastewater treatment should have been investigated and studied. Some of the treatment system was found to be quite satisfactory in removing pollutants. However, there is a strong need to conduct extensive research due to the reuse and reclaiming of car wash wastewater as other potential to reduce scarcity in worldwide rather than disposed it. If it is possible in developing other low cost and simple treatment differ from the treatment that have been reviewed, then these treatments may offer many advantages and commercially attracting consumers and developers of car wash stations, and hence contribute to the way of minimizing pollutants of car wash wastewater.

Acknowledgement

This work is funded by University Tun Hussein Onn Malaysia of Postgraduate Incentive Research Grant (GIPS), Vot No. : 1404. Expression of gratitude is presented to Authorized Translator for the invaluable comments and suggestions.

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