DESIGN OF LOW COST WATER RECYCLE SYSTEM IN A SMALL SCALE FOOD INDUSTRY TO OVERCOME GROUNDWATER SHORTAGE

Ajeng Arum Sari and Edi Iswanto Wiloso

Research Center for Chemsitry, Indonesian Institute of Sciences
PUSPIPTEK, Serpong, Tangerang 15314, Indonesia
Telp: +62 (21) 756-0929, Fax: +62 (21) 756-0549, Email: edi.iswanto.wiloso@lipi.go.id

International Symposium Coupling Sustainable Sanitation & Groundwater Protection
Federal Institute for Geosciences & Natural Resources (BGR), Hannover, Germany, 14-17 Oct 2008

Introduction

Industry and commercial activities overuse and deplete groundwater. It caused adverse impact to the environment, such as decreasing soil surface and intrusion of seawater in some high populated cities in Java, Indonesia. To regulate the use of groundwater, in the early 2008, the administration of the capital city Jakarta announced the plans to increase groundwater retribution as much as four times to around Rp 12.000/m^3, similar to the price of tap water. If this new regulation is implemented, industries in particular small size companies will face problems related to the supply of clean water for its production line. To maintain production continuity and competition level of an industry, the government needs to provide technology support particularly for the small scale industry so that the new policy can be realized in practice. Based on economic considerations, this trend will enhance the implementation of water efficiency, water conservation, and water recycle rather than over exploitation of groundwater and discharge of wastewater with considerable environmental expenditures. To attain adequate water quality for recycling purpose, supplemental water purification system is required beyond conventional secondary wastewater treatment. Health safety is also a parameter of interest because pathogens can exist in partially treated effluents, particularly for specific application such as in a food industry where chlorination is needed. This paper discusses about the design of a low cost water recycle system in a small scale food industry, particularly the development of unit processes to further treat effluent of a secondary treatment system to a sufficient water quality for non-food applications, such as lab cleaning, tray cleaning, shower, laundry, and crop spraying.

Methods

The design process of the water recycle system was started by identifying a water balance or water usage in the designated food industry (Figure 1), and lay outing the existing wastewater treatment system (Figure 2). The main unit in the secondary wastewater treatment system is a biological process involving anaerobic and anoxic conditions known as sequencing batch reactor (SBR). The plant produced treated effluent from the SBR as much as 10 m^3/day with COD, TSS, and total N concentrations of 48.3 ppm, 22 ppm, and 1.43 ppm, respectively. Although these qualities satisfy the discharge standard according to West Java Governor Decree number 6/1999, the effluent discharge permit is only to a limited amount because the plant is actually located in an area which is not allowed to dispose wastewater to the environment. A water purification system is therefore designed to further process the effluent into a sufficient quality water for non-food applications.

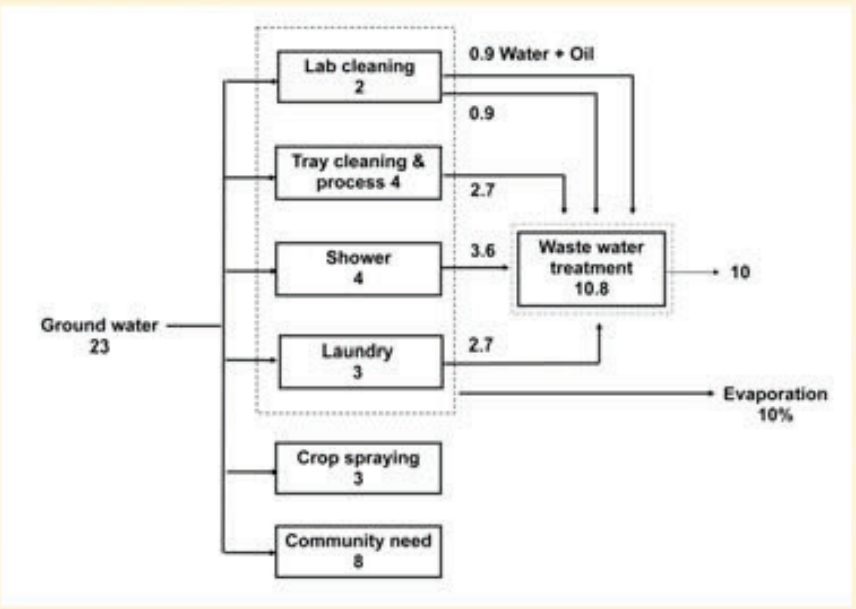

Figure 1. Water Balance (m^3/day)

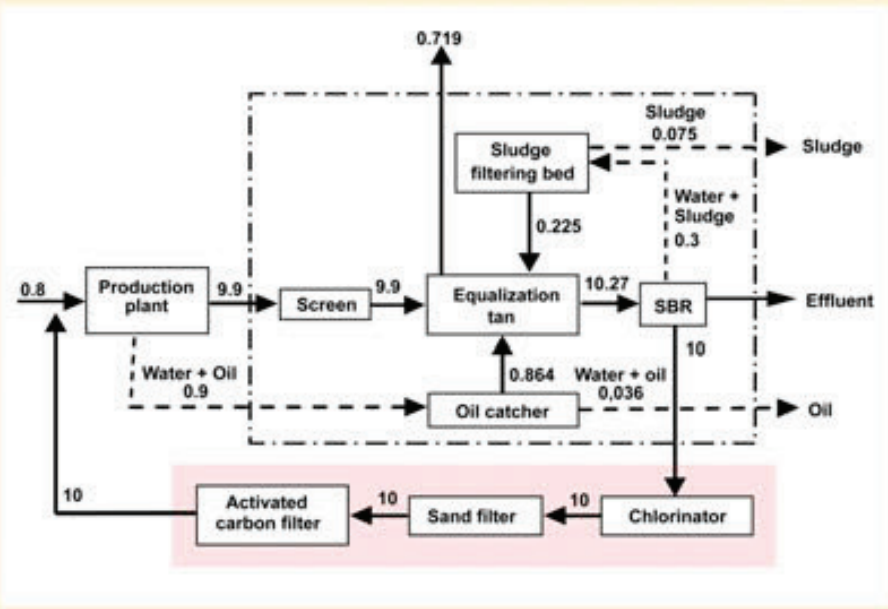

Figure 2. Existing Wastewater Treatment and Proposed Recycle System (m^3/day)

Result

The design of the low cost water recycle system is limited to only three main unit processes. These are the chlorination unit, the 660 L rapid sand filtration, and the 600 L activated carbon filtration (Figure 3). Based on the published design criteria, the quality of the recycled water was estimated to meet the class I water according to the government regulation PP 82 year 2001, a standard for raw water for drinking water, requiring COD, TSS, total N and chlorine maximum concentrations of 10 ppm, 50 ppm, 0.25 ppm, and 0.1 ppm, respectively (Table 1). The parameters shown in the Table is limited only to the key parameters related to the pollution strength of the effluent coming out from the wastewater treatment plant. Total investment to construct the above recycle system depends on the type of material used. Stainless steel and fiber glass will cost Rp 79.500.000,- and Rp 35.000.000,- respectively. The pay back period on the construction of the system is 2 to 3 years, and the operational cost related to the supply of fresh water and effluent discharge will reduce by of Rp 25.000.000,-/year.

Figure 3. Unit Processes

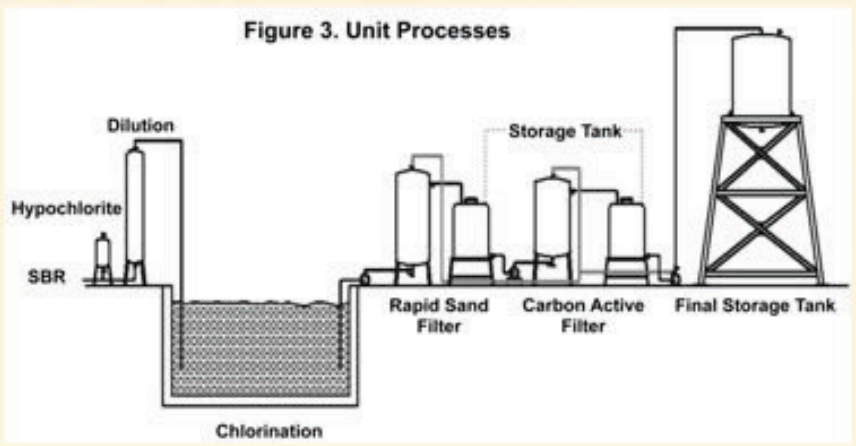

Table 1. Estimated Quality of Recycled Water and Standards

Parameters	Unit	SBR effluent	Recycled water (estimated)	Indonesian Water Standards		
				Class-1 raw water PP 82/2001	Drinking water Permenkes 907/2002	Drinking water in package SNI 01-3553-2006
pH	-	8.33	8.33	6-9	6.5-8.5	6.0-8.5
N-total	mg/L	1.43	-	0.25	-	-
Nitrate	mg/L	0.176	0.176	10	50	45
Nitrite	mg/L	0.004	0.004	0.06	3	0.005
$N\text{-}NH_3$	mg/L	-	-	0.5	1.5	0.15
COD	mg/L	48.3	9.66	10	-	-
MBAS	mg/L	0.289	0.17	0.2	-	-
TSS	mg/L	22	6.6	50	-	-
Chlorine*	mg/L	-	0.02	0.1	5	0.1

* Chlorine dosing 11 ppm

Conclusions

The application of water recycle system in a small scale food industry if a new tariff for groundwater is implemented will give significant benefits not only for environment (reduction in groundwater usage and effluent discharge), but also economy (reduction in operational cost related to the supply of fresh water and effluent discharge).

Acknowledgements

The authors would like to thank Mr. Muryanto, Ms. Diana Rahayuningwulan, Mr. Efendi, Ms. Vera Barlianti, and Mr. Dian Haelani of the Research Center for Chemistry-LIPI, Mr. Joko Supardi and Ms. Lindajati Tanuwidjaja of the food industry for valuable discussion.

Chemistry - Indonesian Institute of Sciences
Research Center for Chemistry
LIPI