Continuous Water Recycling For Reusable Plastic Containers

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ABSTRACT

The pilot study and full scale installation of UF-RO based System to recycle around 75% of wastewater from plastic pallet washing facility is described. The installed System had several issues that had to be resolved. Cooling tower was installed to cool water to below 85 ^{o}F. Ion exchange Systems were installed after the UF membranes to remove iron and silica. Multiple filtration systems were installed to reduce TSS before the UF membranes (hollow fibers GE membranes). After that, the reuse System has been working and producing excellent quality effluent that is reused in the washing machines.

KEYWORDS: plastic containers washing water; water reuse; filtration; UF; RO

INTRODUCTION

Problem

Keeping in line with IFCO corporation sustainability initiatives, RPC Division in McDonough, GA set out an effort to conserve water at the plant. To help achieve this goal it was decided to recycle the effluent water from several lines of plastic pallet washing. The clean sanitized pallets are used to transport produce (fresh fruits and vegetables) from farm distribution points to supermarkets. The recycling water system was to be designed to treat city water used in the washing process collected in a sump pit, with a moderately high content or organic and inorganic debris and detergent and common hardness and tap water ions. Contaminants include TSS between 150 and 2,500 mg/l; COD between 250 and 4,500 mg/l, salinity up to 2,500 mg/l; detergents up to 80 mg/l, some silicates and ferric iron.

Goal

Recover as much wash down water as possible; clean it and then fully reuse it continuously in the container washing process. Containers do come in contact with food.

RESULTS

To achieve the above mentioned goal we performed pilot studies and designed treatment system that included multistep pretreatment with screens to remove large objects, followed by multibasket filters, fine disk filters, hollow fiber ultrafiltration, and spiral wound low pressure TFC RO membranes. The System can treat up to 18,000 gallons of wastewater per day. An automatic system for gas scouring of UF and nonchemical as well as chemical membrane cleaning was also installed. Chemical membrane cleaning is performed with citric acid (acid wash) and caustic with anionic detergents. Installed

system had serious issues and following upgrades had to be installed: cooling tower to cool water below 85 F, ion exchange system to remove iron and silica after the UF step, and replacement of media depth filter with large pore disk filters. Also chlorination tank was installed after the RO membranes.

UF System is based on three OSMOS PVC hollow fiber membranes with MWCO 100,000 D (0.05 microns) and 9.2 m^2 surface area each. Chlorine tolerance of the membranes is around 20 ppm. Membranes are run at 50 psi. Membranes have to be chemically cleaned once a week.

RO System is based on seven Osmonics Desal low pressure AG 4040 units. Those TFC membranes have nominal rejection around 95-98% with recovery up to 75%. Standard operating pressure is at 220 psi. Each unit can handle up to 2,200 gallons per day. Membranes were fed 15 ppm of antiscalant solution. GE deionization systems were installed after UF membranes to prevent iron and silica precipitation at RO membranes. Membranes are chemically cleaned twice a month.
The performance of the UF and RO systems is summarized in Table 1.

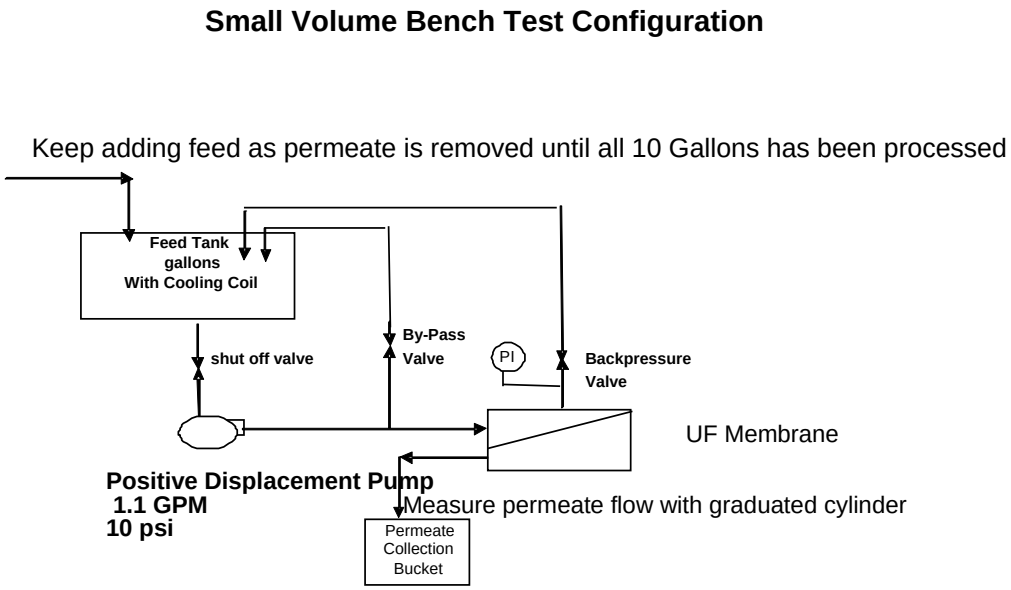
Table 1. The performance of the UF and RO membranes

	Influent	**after UF**	**after RO**
pH	11	6.0	5.5
Conductivity Micromhos	860	400	12
TSS/ppm	1.200	1	0
Iron/ppm	1.2	<0.05	0
Sodium/ppm	150	150	1.1
Potassium	55	55	0.5
Chloride	50	50	1.0
Calcium ppm	47	20	1.0
Silica/ppm	21	9.5	0.6
Sulfur total/ppm	19	16	1
Alkalinity P/ppm	147	7	0
Alkalinity M/ppm	262	3	<2
Hardness total/ppm	50	23	1.0
COD/ppm	1,300	350	15

APPENDIX 1

Summary of the Pilot Tests

Figure 1. Ultrafiltration Process Description.



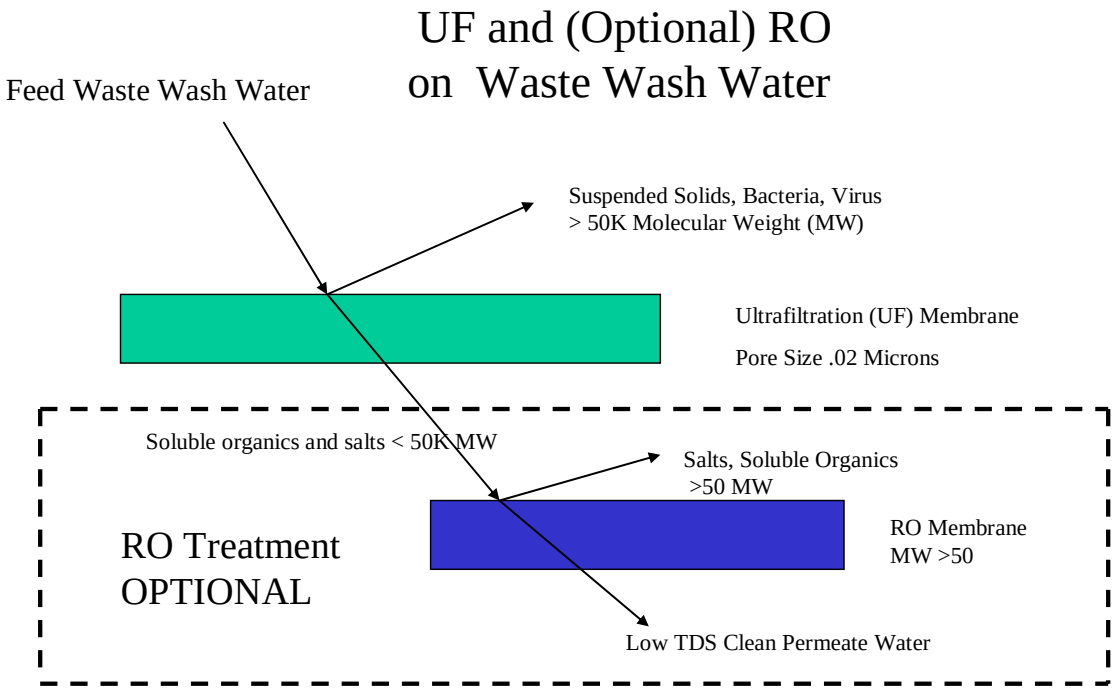


Figure 2. UF-RO pilot system schematic

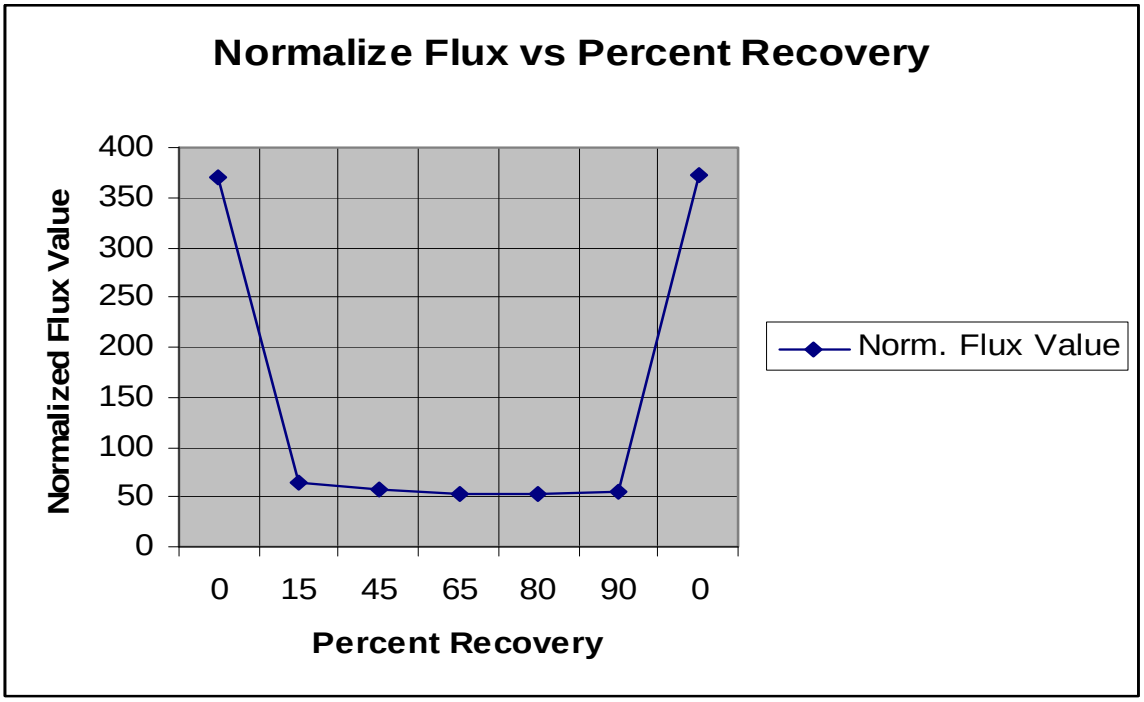
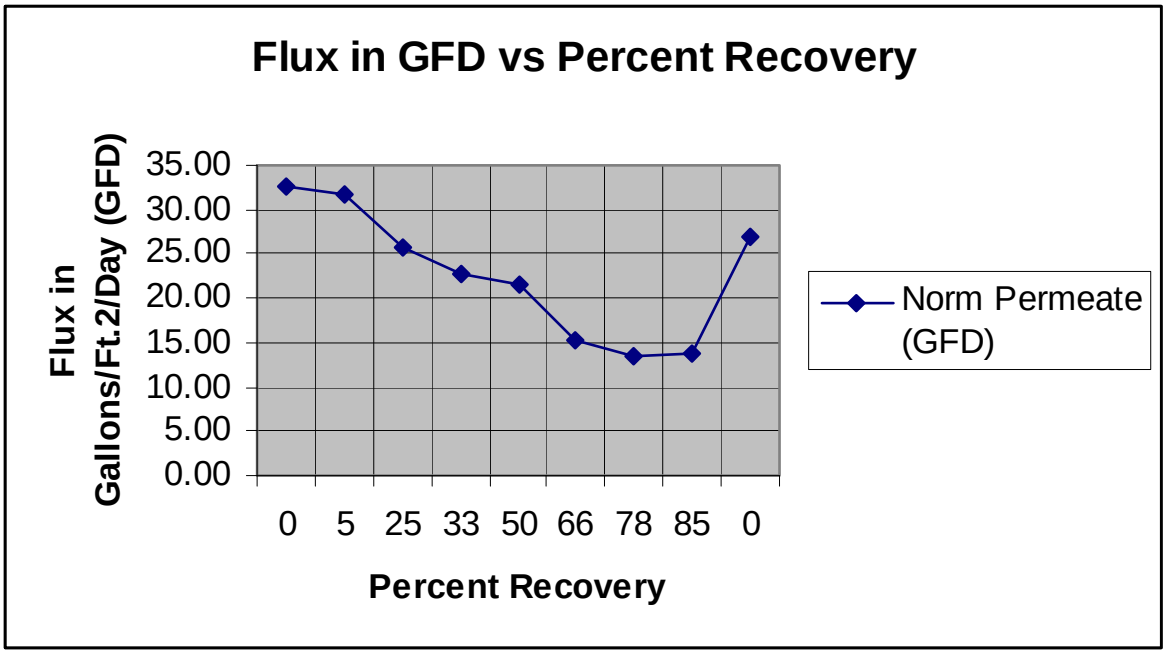


Figure 3. UF membrane performance

Figure 4. RO membrane performance

RO Graphical Representation of the Data



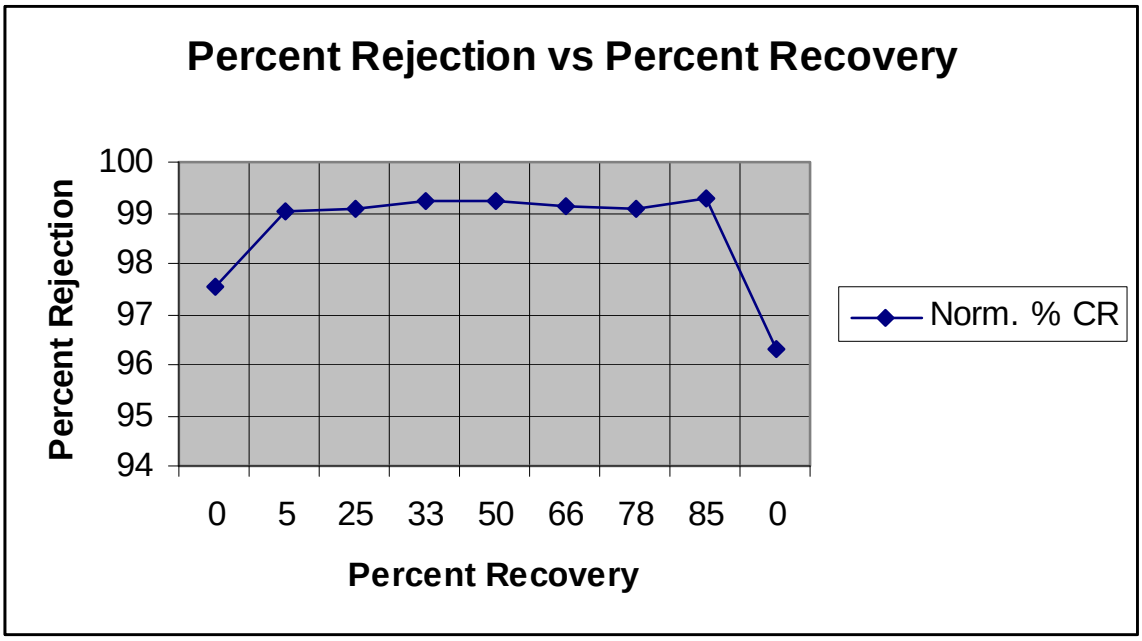


Figure 5. Percent rejection vs. Percent Recovery for RO membrane

Figure 6. Picture of the RO System

Figure 7. Picture of the UF System

CONCLUSIONS

IFCO UF-RO based system can now recover approximately 70-75% of the water it consumes to continually utilize in the washing process. This helps achieve planned water savings, and the plant goals. Treated water is better quality than the tap water (no issues with scale formation). This eliminates need for tap water softening. TSS after RO System are 0 ppm, and so are FOG's and BOD's, with COD's around 10-15 ppm. Salinity is removed to around 20 ppm. After chlorination step, the total coliforms and fecal coliforms are nondetectable.