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Analysis of Secondary Wastewater Treatment

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ABSTRACT

At the Irvine Ranch Water District, two types of secondary treatment are utilized: a sludge and Dual Media Filters (DMF) process and Membrane Bioreactor (MBR) process. This study was proposed to analyze the electrical conductivity (EC) of each secondary effluent and possible reasons for differences. After testing the two effluents using an electrical conductivity probe and ion chromatography, it was discovered that there is no significant difference between the two, though secondary treatment raises the nitrate levels in general.

SECONDARY TREATMENT

Secondary water treatment generally involves the removal of oxygen-demanding compounds and species. Usually activated sludge breaks down organic compounds, then is filtered out.

DMF systems pass wastewater through activated sludge systems with both aerobic and anaerobic microbes. The sludge is removed, then the effluent is filtered by a sand filtration system (Manahan). The DMF system is run almost entirely by gravity. Pumps are only used during the filtration process.

MBR systems are a newer technology. They use a more streamlined sludge system, followed by a membrane filtration system. Benefits of this process include: decreased sludge production, effluent of a consistent quality, increased fecal coliform and virus removal, and increased removal of Copper, Zinc, Anionic detergents, herbicides, FS, and TGC (Melin). The MBR system is above grade, so it requires a large amount of energy compared to the DMF system.

HYPOTHESES

The EC of the DMF effluent was expected to be slightly lower. Factors involved are: addition of bleach to the DMF sand filters, which dissolves into ions that increase EC; increased ion removal by the MBR filter, which allows for less electron movement; and effects from the chelation of metals from organic compounds, which may result in a higher concentration of retained ions and a decreased amount of conductivity.

	Bleach addition	Ion removal	Chelation; movement prevention	Chelation; conductivity prevention	Expected Net Change
MBR	X	↓↓	↑	↑	X
DMF	↑	↓	↓	↓	↓

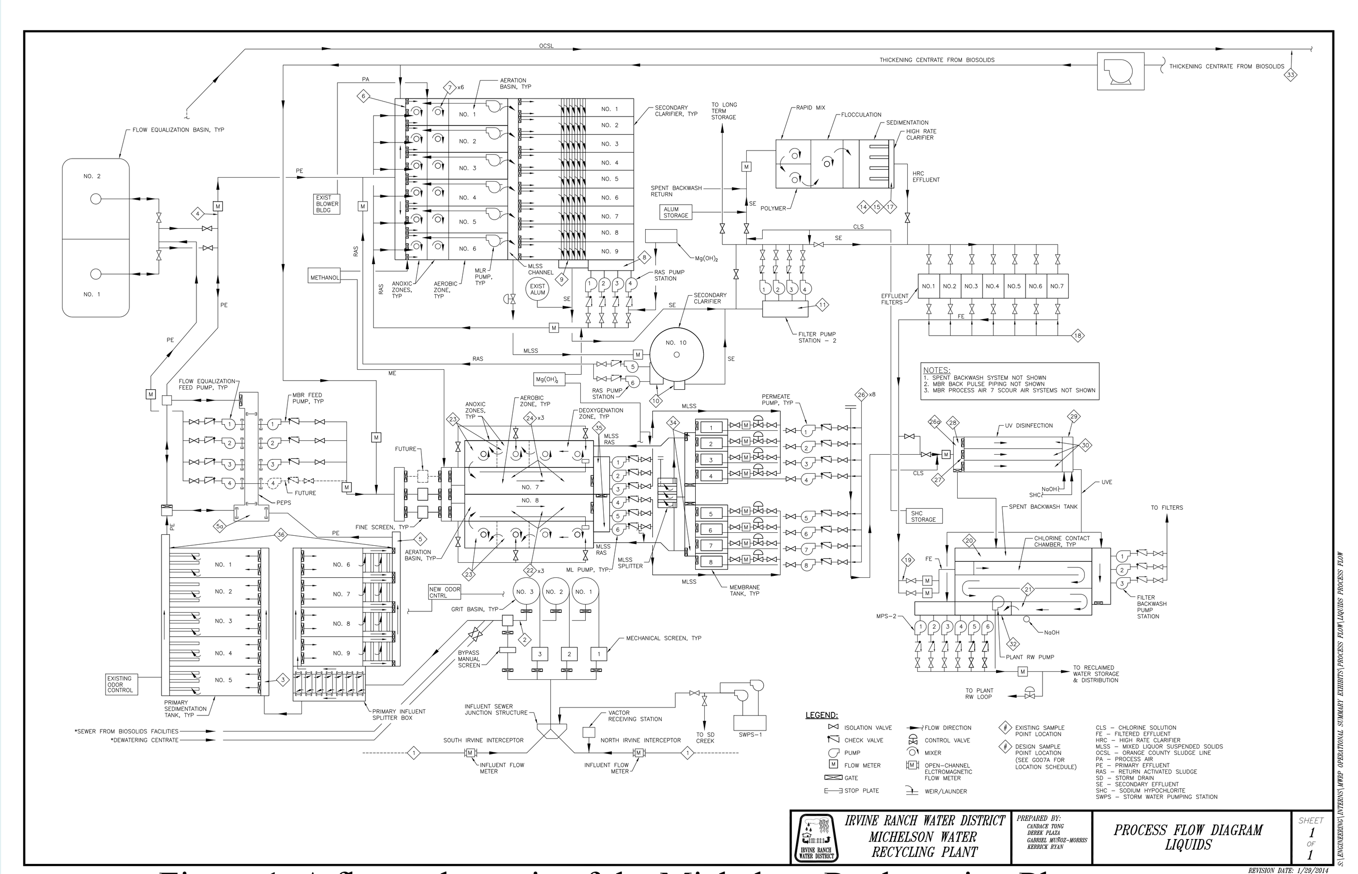
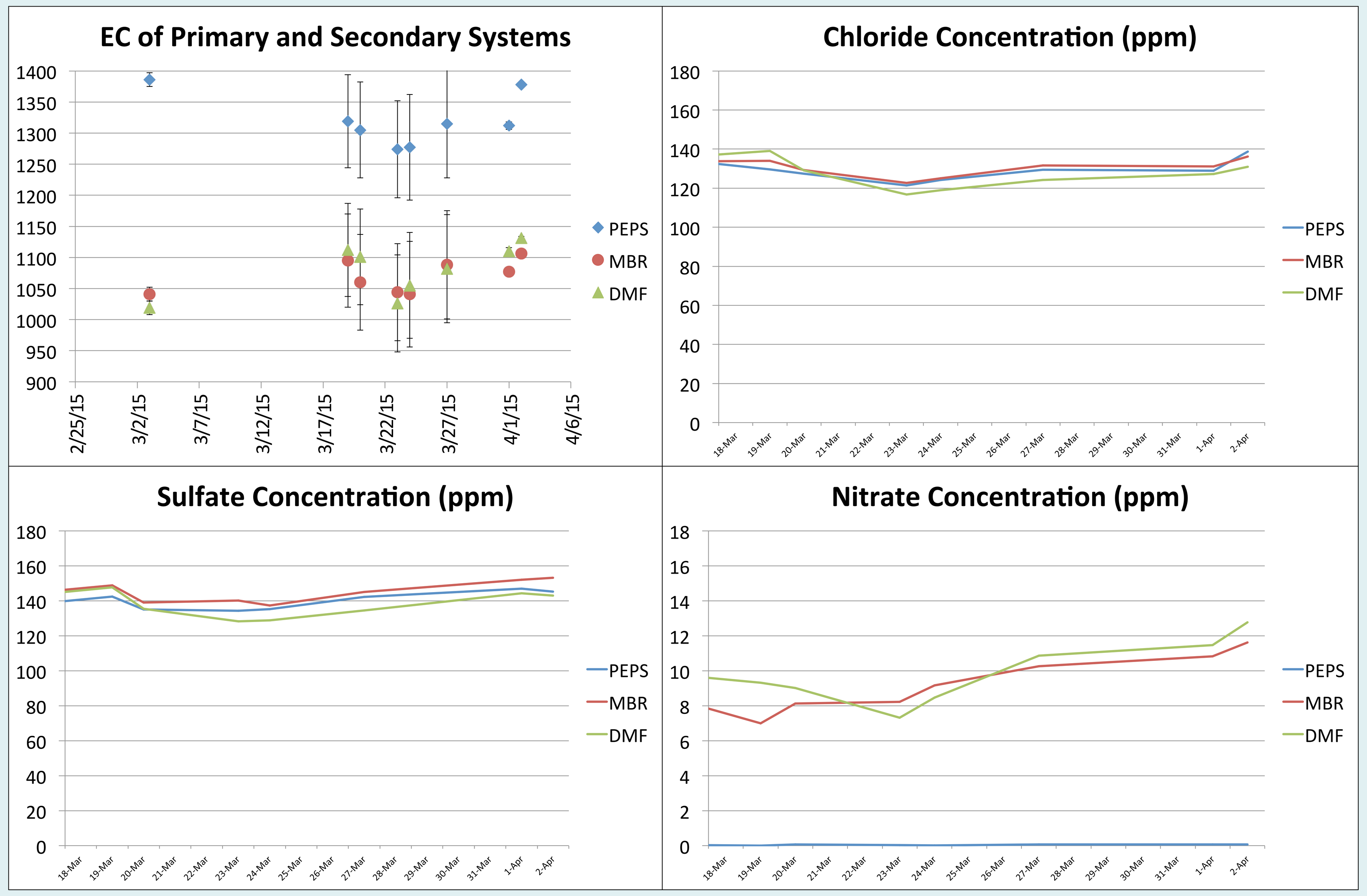


Figure 1: A flow schematic of the Michelson Reclamation Plant

METHOD

Due to time constraints, only the first two hypotheses were tested. Samples were collected from sites 5a, 18, and 24, which are primary (PEPS), DMF, and MBR effluents, respectively. PEPS samples were collected after primary treatment during the mixing phase before secondary treatment. These samples are used as a control. Samples were refrigerated until testing. Electrical conductivity was measured under standard method 2510B and Ion chromatography was conducted according to method 4110B.

RESULTS



DISCUSSION

The T-tests between the two secondary effluents showed values of 0.55, 0.17, 0.17, and 0.97 for EC, chloride concentration, sulfate concentration, and nitrate concentration, respectively. With 95% confidence, we can say the samples have no significant differences.

When each sample was compared to primary effluent, no significant differences were found except a difference between the nitrate concentration. Both secondary treatments had a much higher concentration of nitrate than the primary effluent. Nitrate is a byproduct of the sludge; organic nitrogen is converted to ammonia, which then undergoes nitrification to produce NO_3^-. It is not surprising the secondary effluents had increased levels of nitrogen.

CONCLUSION

In conclusion, the electrical conductivities of each secondary effluent are very similar. Neither showed a significant change in EC, chloride, sulfate, or nitrate concentration. In fact, it was shown primary treatment does not affect chloride and sulfate concentrations at all. There was a significant change between nitrate concentrations, however.

Future tests should determine the amount of chelating compounds in solution and their affect on the effluent electrical conductivity. In addition, a more detailed study of the ions should be conducted. Previous studies have analyzed the difference in lab-scale MBR and DMF effluents or have compared the effluents from different facilities. The layout of Michelson Reclamation Plant allows for a more accurate study of full-scale production while eliminating environmental factors and changes due to influent compositions.

REFERENCES

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