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Memo

To:	Core Area Wastewater Treatment Program	From:	Dr . Bob Dawson, P.Eng.
	Project Board		Sender's Office
File:	111700431	Date:	August 21, 2016

Reference : White Paper - Micro-plastics in Municipal Wastewater

This white paper has been prepared to assess the removal of micro plastics using conventional secondary and tertiary wastewater treatment processes.

Micro-plastics or micro-beads are synthetic polymer particles ranging in size from 0.1 microns to less than or equal to 0.5 mm in size. They are manufactured to be components of personal care products such as toothpaste, facial cleaners, and cosmetics. They are also components of industrial abrasives, textile printing, cleaning products and pharmaceutical products. They gain access to the municipal sewer system when discarded at residences or businesses. Miicro-plastics can also result from the breakdown of larger plastic materials such as fibres from synthetic plastics or clothing which are termed secondary micro-plastics. Their chemical composition varies but commonly they consist of polyethylene, polyester, polystyrene and numerous other polymers most of which take a long time to degrade by natural processes and remain in the aquatic environment for a long time.

Among the concerns raised with micro-plastics is that aquatic organisms such as fish, shellfish, zoo-plankton ingest them as potential food sources with significant impact on their physiology, reproduction, and health. There are also direct toxic effects due to ingestion and absorption.

Municipal wastewater effluents, storm runoff, industrial discharges are all sources of micro-plastics. Several studies have recently been undertaken which show that between 98 and 99 % of the micro-plastics contained in raw municipal wastewater are removed by secondary treatment processes such as settling, skimming and bio-flocculation (Fionn , Murphy et al 2016, Steve A Carr et al 2016) . They generally end up in the bio-solids. In spite of these removals, measurable quantities of micro - plastics are discharged. Another study of seven tertiary plants in Southern California indicated good removal of micro-plastics in tertiary treatment plants.

For the CRD project as originally proposed in the liquid waste management plan greater than 98% of the micro-plastics would be removed because the BAF bioreactor provides a packed bed filter with a fine strainer underdrain system prior to discharge. If a tertiary disc filter is also added downstream of the BAF , small openings in the disc fabric combined with an operational “schmutzdecke” or filter organic layer will further polish the effluent and remove some additional micro-plastics.

A significant amount of scientific environmental research (Environment and Climate Change Canada) has been carried out over the last 10 or 15 years to show that the accumulation of micro-plastics in the world’s oceans is increasing along with damage to the aquatic ecology and it is time for control of production and subsequent discharge of these materials Most regulatory jurisdictions and US scientists have concluded that the most efficient way to eliminate the problem of micro-plastics in the aquatic environment is to ban the use of micro-plastics in the production consumer products, and their sale or distribution. (Waterborne Environment Inc. 2016) For example, in the USA

Reference: Micro-Plastics in Municipal Wastewater

many (10) states have initiated such bans on personal care cosmetics and pharmaceutical products. On December 28 , 2015 US President Obama signed the "Micro-bead-Free Water Act" which prohibits the manufacture and introduction of rinse-off cosmetics containing intentionally added micro-beads starting 2017. In Canada some provinces have either passed or are contemplating micro-plastic control legislation. In June 2016 The Government of Canada added micro-beads to the List of Toxic Substances under The Canadian Environmental Protection Act.

During the planning and indicative design stages of the CRD project several of the stakeholders indicated that a treatment process train should be selected that would eliminate micro-plastic discharges to the environment. This could be achieved by providing a physical barrier to their discharge by utilizing membrane technology. For the CRD project several groups have indicated that membrane technology is the preferred technology either as a MBR process or membrane filtration as a tertiary unit process. Both membrane techniques would add at least 15 to 20 % to the capital cost of secondary treatment and probably 20% to the annual operating cost. In addition the long term impact of micro-plastics and associated abrasives on membrane fouling is uncertain. Considering the timing of new regulations (2017 to 2020) for restricting the addition of micro-plastics to personal care and cleansing, pharmaceuticals and cosmetics, it would seem that requiring membrane technology application to the CRD project would raise the costs unnecessarily.

Conclusion

Based on studies of existing plants, secondary treatment will remove a significant amount of micro-plastics. Any residual micro-plastics which pass the secondary process could be removed by tertiary filtration. However it is noted with future regulations banning micro-plastics, they are not likely to be an issue.

References :

1. Environment and Climate Change Canada, (July 2015), " Microbeads- A science Summary".
2. Fionn Murphy et al, (2016)" Wastewater Treatment Works as a Source of Microplastics in the Aquatic Environment", Environmental Science and Technology 50(11) 2016.
3. Steve A Carr et al,(2016), 91, 171, 182 "Transport and Fate of Microplastic Particles in Wastewater Treatment Plants" Water Research , June 2016.
4. Waterborne Environment Inc, (2016), "Micro-plastics, Microbeads and Regulations; State of the Union".

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Dr. Bob Dawson, P.Eng.