LECTURE-29+30

(4) SEWAGE TREATMENT PLANTS

Municipal sewage is a complex mixture of liquid wastes flushed down sewers by residential, commercial, institutional and industrial sources. It contains **human wastes**, of course, and bathroom tissues, which arrive at the treatment facility largely in the form of **dissolved organic** matter and suspended fibrous material, and which contribute large loadings of **nitrogen, phosphorus and pathogens**. These are the substances that municipal STPs are chiefly designed to treat.

Municipal STPs also receive many other types of wastes, however, which are not as responsive to treatment — some are only partially degraded during sewage treatment, some tend to accumulate in **sewage sludges**, and other wastes pass unaffected into the final effluent and the receiving waterway.

For example, commercial and industrial facilities discharge a wide variety of liquid wastes to sewers, often containing persistent organic pollutants, metals, and organic materials that resist decomposition. Residential and industrial cleaning agents and miscellaneous grit and plastic debris are also common constituents of municipal sewage. Human wastes contribute trace quantities of hormones and pharmaceuticals to the sewage mixture, some of which may have the ability to disrupt the functioning of animal and human endocrine systems.

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NEGATIVE EFFECTS OF STPs

According to Environmental scientists, the treated effluents of municipal STPs are a leading source of the **biochemical oxygen demand (BOD), total suspended solids (TSS), nutrients, organic chemicals and metals** that are discharged into waters. Persistent **organic pollutants**, **bacteria** and other types of **pathogens are also commonly associated with STP effluent**

The impacts of STP effluent on **water quality** and **ecosystems** can vary greatly, depending on factors such as the **volumes and quality** of effluent being discharged and the ability of the receiving waterway to dilute and assimilate contaminants. In the approval process for STP discharges, regulating agencies usually consider the **assimilative capacity** of watercourses and **variable flow rates**.

Other things being equal, **larger lakes** and rivers can dilute **more** effluent than smaller ones, and **fast-flowing, well-oxygenated** rivers have a **greater** assimilative capacity than slow-moving rivers. Where municipal STPs discharge into protected bays or harbours (such as Toronto's Ashbridges Bay), concentrated effluents may have stronger local impacts on fish habitat or nearby bathing beaches.

Waterways that receive a **high proportion** of effluent from **primary** treatment plants (effect of sewage treatment plant quality) may be more seriously impacted than waterways that receive secondary treatment effluent. For example, in 1991, **Lake Superior**, the Ottawa River and the St. Lawrence River each received **over 80** per cent of their Ontario-source STP volume from plants providing only primary treatment.

According to Environmental scientists, municipal STPs contribute much higher loadings of **phosphorus and nitrogen** to waterways than industries that discharge directly into lakes or rivers. Increases in phosphorus levels

L29-L30

can lead to long-term, **fundamental changes** in the structure and **species mix** of aquatic communities.

One of the first results can be the proliferation of algae and other aquatic plants. As these plants decay and die, oxygen in the water can be used up, and fish kills can result.

It is noted in 2001/2002 annual report that a number of lakes and rivers in southwestern Ontario are exhibiting elevated levels of **nitrogen** and **phosphorus**. **Run-off** from agricultural land is thought to be the major contributing factor, but municipal STP effluents are also contributing to these loadings. Phosphorus loadings, especially to Lake Erie, have been a long-standing concern. Bi-national controls in the 1970s led to reduced phosphorus loadings from STP effluents, and great improvements in the health of Lake Erie. But the concentrations of phosphorus in Lake Erie continue to exceed guidelines, and the lake is once again in trouble.

STP effluents contribute not only to overall **long-term loadings** of pollutants; they can also be acutely **toxic to fish and other aquatic organisms** living near the discharge point. “Acutely toxic” means that test organisms cannot survive for more **than hours** or days when exposed to the effluent. According to a recent Environment Canada overview, under estimated average conditions, some municipal wastewater discharges could be toxic for **10–20 kilometres** downstream. Plants and animals that live on the bottom of lakes and rivers may be disrupted up **to 20–100 kilometres** from STP discharge points.

Acute toxicity is most often caused by high levels of **ammonia** and **chlorine** or **heavy metals and organic contaminants**. Ammonia (a product of nitrogen metabolism) appears to be a particular problem; municipal STPs are the leading quantifiable source of ammonia entering waterways..

L29-L30

Many municipal STPs add chlorine to their final effluent during summer months to kill bacteria, viruses and other pathogens, and **chlorine** is also **acutely toxic to fish**.

Moreover, the combination of chlorine and ammonia in water will form **chloramines**, which are highly toxic to fish and other organisms. Only a very small percentage of STPs address this problem by **de-chlorinating** their effluent before discharging it.

However, a number of STPs (including Windsor, Sarnia, Barrie, Georgetown, London and Peterborough) have moved to **ultraviolet** disinfection of their final effluent, which eliminates the chlorine toxicity problem.

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(5) WATER TREATMENT PLANTS

The compounds in the **effluent** of water-treatment plants could be divided into two groups in terms of how they affect the river ecosystem: the ones that boost the activity of the organisms, and the ones that harm or hamper it.

The first group comprises **organic matter and nutrients**, the so-called assimilable ones. In their presence, the activity of the river organisms is **increased** since their growth is encouraged. "Yet above a certain point or concentration they may be **toxic**. One of the functions of water-treatment plants is in fact to lower the concentration of these compounds to acceptable levels.

However, the components of the other group are **toxic pollutants**, ones that harm **river organisms** in one way or another. In a research they concentrated on drugs dissolved in the water. We regard them as indicators of all the toxic pollutants, but one has to understand that together with the drugs there is a variety of toxic compounds, such as **heavy metals, pesticides** and components of **soaps**, and that it is when they are taken together that they are harmful. None of them are removed in the water-treatment plants because these plants are not equipped for that purpose.

NEGATIVE EFFECTS

As they have been able to see, pollutants of one type and another affect the various river organisms. They have noticed the influence of assimilable compounds mainly in respiration, in other words, in the processing of organic matter. When the concentration of assimilable compounds increases, respiration also increases. Respiration is much greater at the place where the

L29-L30

effluent from the water-treatment plants is incorporated than in the upriver stretches, and when it heads downriver, the concentration of assimilable compounds gradually decreases and with it respiration .

On the other hand, the **toxic pollutants** affect **photosynthetic organisms** more. The toxic pollutants cause the level of production of these beings to be lower than what it should be at a specific point. Production usually depends on the level of **sun light** as it is essential for photosynthesis to take place. When mixed with the water from the treatment plant, however, we do not measured levels of production in accordance with the quantity of light existing. We have also seen that these organisms have activated a mechanism to protect themselves from the stress produced by the toxic substances.

Various researches have shown that "water treatment plants are not totally efficient, and it is something to which attention should be paid if we want the activity of the rivers to remain healthy." By way of conclusion, "One would have to see which is the more appropriate situation: the current one with lots of small water treatment plants that leave their impact on many stretches of the river, or harm fewer stretches by building fewer but bigger water-treatment plants. But there is also the possibility of increasing the efficiency of the treatment plants by, for example,fitting filters to collect the compounds that are not removed at the moment. But in this matter, it will be difficult for the water-treatment plants to implement them owing to their high cost.