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WATER QUALITY PARAMETERS FOR VEGETABLE WASHWATERS

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Introduction

There are many different measures used to identify the quality of a water sample. The following parameters are key ones used to describe the quality of wastewater generated on farms that wash vegetables. They include measures of water clarity, nutrients, organic material, pathogens, and dissolved oxygen.

Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Turbidity

Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Turbidity are all measures of water clarity. TSS is a measure of the concentration of solids (mg/L) with particle size greater than 1-1.2 microns. Particles smaller than that are considered dissolved solids and are quantified as TDS in mg/L. A Turbidity measurement is another way to quantify the solid load of water and is measured in nephelometric turbidity units (NTU); examples of solutions with different turbidity measures are shown in Figure 1.

Vegetable washwaters often contain high TSS and have high turbidity. The main component of the solid load is the soil that is washed from the vegetables. Suspended solids are considered problematic in wastewater because they reduce water clarity, clog plumbing and irrigation lines, interfere with disinfection technologies, and add sediment to aquatic systems (CCME 2006; MOECC 2003). The solids can also contain other unwanted

Figure 1: Examples of solutions with varying turbidity, from left to right: 10 NTU, 20 NTU, 100 NTU, and 800 NTU (photo credit: HMGA)

surface water pollutants, such as nutrients (nitrogen and phosphorous) and organic matter, and they can provide attachment sites for pathogens (MOECC 2003; MOECC 1994).

Nitrogen

Nitrogen (N) in wastewater can be found in a number of forms. The most common forms of nitrogen in agricultural wastewater are organic nitrogen, nitrate (NO_3^-), and ammonium/ammonia (NH_4^+/NH_3) (OMAFRA 2005). Nitrate and ammonium/ammonia can be measured directly and are reported in mg/L. Total Kjeldhal Nitrogen (TKN) in mg/L is a measure of both organic N and ammonium/ammonia N, and the amount of organic N can be calculated by subtracting ammonium/ammonia N from TKN. Nitrate levels in vegetable washwater are often quite low and are ordinarily not an issue; however, both organic N and ammonium/ammonia levels can be high and may require treatment before discharge (MOECC 1994).

When excess N is discharged into the environment, it can cause a number of issues. Ammonia can be extremely toxic to many different aquatic species and therefore discharge levels are strictly regulated (OMAFRA 2005). Nitrate is toxic to humans if the concentration is high enough and both ammonia and nitrate can cause nutrient imbalances and alter the biological makeup of an aquatic system (OMAFRA 2005). Organic N, found in vegetative material, is often bound to organic material and is not immediately free to react. However, as these larger organic molecules breakdown, the N is released and can adversely affect the system.

Phosphorous

Phosphorous (P) in agricultural washwater can be in the form of phosphate (ortho-phosphate, PO_4^{3-}), particulate P, and dissolved P. Total Phosphorous (TP) is a sum of all forms of P and is the commonly used parameter when assessing water quality. All forms of phosphorus can be found in agricultural wastewater at moderate levels (CCME 2004). TP levels are considered an important pollutant and are strictly regulated (CCME 2004; MOECC 1994). Excess P introduced to a water body can cause eutrophication events that lead to algal blooms. When the excess algae dies and decomposes, oxygen in the system is depleted which leads to the death of fish and other aquatic organisms (CCME 2004).

Organic Material (BOD and CBOD)

The amount of organic material (OM) in wastewater is often represented by how much oxygen the breakdown of the material consumes. This is known as the biochemical oxygen demand (BOD) or carbonaceous biochemical oxygen demand (CBOD) and both are reported in mg/L. The oxygen demand of an organic load is employed because one of the main problems associated with excess OM in a system is the rapid loss of oxygen due to its consumption as OM breaks down (CCME 1999). Excess OM in water can also cause other issues such as the clogging of pipes and reductions in the efficiency of disinfection systems.

Vegetable wash water often has high oxygen demands due to its large organic loads. OM from the vegetables and soil easily enters the wash water and needs to be removed before discharge or reuse (OMAFRA 2013; MOECC 1994).

Pathogens

Pathogens, both human and plant, in agricultural wastewater are an important concern for both food safety and environmental reasons. Pathogen levels in water used for washing produce are strictly monitored under food safety regulations and disinfection technologies are often required to ensure potable water standards are met. Pathogen levels in discharged wastewaters also need to be monitored, as there is a potential for environmental contamination, which can compromise the quality of shared water resources (OMAFRA 2006; MOECC 1994).

Since analyzing every water sample for all possible pathogens is not a cost effective or technologically possible option, agricultural water samples are routinely analyzed for the presence of *E. coli* and fecal coliforms. The presence of either in a water sample is an indication of the need for further and more effective water treatment.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) is the concentration of oxygen in water, reported in mg/L. Healthy bodies of water generally have DO levels ranging from 7 - 10 mg/L and if the concentration drops below 5.5 mg/L, detrimental effects on aquatic organisms may be observed if those organisms are continually deprived of oxygen (CCME 1999). DO is affected by temperature, water depth, water flow velocity, and the biological components of the system. When discharging wastewater to the environment, it is important to ensure the DO levels are not adversely affecting the surrounding ecosystem.

Vegetable wash water can be high in organic material (measured by BOD or CBOD) and the natural breakdown of organic material in water consumes oxygen, causing DO levels to drop (CCME 1999). Therefore, these two parameters are often related.

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