

Section 4 Nutrient Addition

Bacteria present in wastewater plants require a balanced diet of carbon, macro nutrients and micro-nutrients. Where there is a shortfall or an imbalance in any of these nutrients, a wastewater plant can perform poorly or fail completely.

Carbon

Carbon is the basic building block for heterotrophic bacteria. In wastewater, it is usually measured in terms of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Bacteria use carbon as a basic building block and in cases of de-nitrification and enhanced phosphorous removal it is vital in promoting anoxic and anaerobic respiration. The amount of carbon dictates the amount of bacteria that may be sustained in the aeration basin. This is expressed as the food : micro-organism (FM) ratio and the standard figure is 0.1

Working out the F:M Ratio

Food Calculation

The food is measured as the amount of BOD entering the wastewater plant per day.

If a inflow is 100m³ per day with a BOD of 200 mg/l, the total food is 100,000litres multiplied by 200 mg. The total is 20 million mg per day, or 20 kilograms.

Micro-Organism Calculation.

The micro-micro-organism concentration is the volume of the aeration basin multiplied by the mixed liquor suspended solids (MLSS) in mg/l. If The aeration basin was 60m³ and the MLSS was 3350mg/l then the amount of micro-organisms would be:

60,000 litres multiplied by 3350mg. The total is 201 million mg, or 201 kilograms.

Therefore the f:m ratio is 20 kilograms divided by 201 kilograms or 0.995. This is close enough to be taken as 0.1 and no carbon addition is needed.

However, if this was a wastewater plant for a university or a manufacturing company that was to close for an extended holiday, it is clear that extra carbon is required in the short-term to keep the plant alive. This can be artificially added in the form of carbon rich additives such as citric acid, sodium acetate, sugar, molasses or alcohols.

Nitrogen and Phosphorous

Wastewater plants that process carbon rich waste streams quite frequently have a deficiency in nitrogen or phosphorous. It can be completely absent, or in a form not readily accessible to the biological population. This manifests itself in poor settlement and bulking and can lead to large numbers of filamentous bacteria. The nutrient requirement is 100 kg Carbon: 5kg Nitrogen: 1kg Phosphorous.

Trace Elements

Wastewater plants usually have sufficient trace elements present in the influent. In cases where there is a deficiency, there is a dramatic reduction in the performance of a plant. The amount of trace elements required is rather small but where it becomes a limiting factor in respiration it has a major bearing on final effluent quality. Production processes that use de-ionised or purified water can usually benefit with a small trace element addition.