glucose, oxygen consumption can be easily related to the carbon content of waste water under aerobic conditions.

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O \tag{16.26}$$

According to the stoichiometry of this reaction 1.07 g of oxygen is required for the oxidation of 1 g of glucose.

Samples of waste water need to be properly diluted to obtain an accurate BOD_5 measurement, seeded with active bacteria, and incubated at 20°C for 5 days along with an unseeded blank. BOD_5 is calculated using the following equation:

$$BOD_5 = [(DO)_{t=0} - (DO)_{t=5}]_{sample} - [(DO)_{t=0} - (DO)_{t=5}]_{blank} \tag{16.27}$$

BOD measurements have some shortcomings. This method is applicable only to biodegradable, soluble organics and requires a high concentration of active bacteria preadapted to this type of waste. Moreover, if organic compounds are refractory, 5 days of incubation may not suffice, and 20 days of incubation (BOD_{20}) may be required.

COD is a measure of the concentration of chemically oxidizable organic compounds present in waste water. Organic compounds are oxidized by a strong chemical oxidant, and using the reaction stoichiometry, the organic content is calculated. Almost all organic compounds present in waste water are oxidized by certain strong chemical oxidants. Therefore, the COD content of a waste-water sample usually exceeds the measured BOD ($COD > BOD_5$).

A typical chemical oxidation reaction (unbalanced) is

$$C_aH_bO_c + Cr_2O_7^{2-} + H^+ \xrightarrow{\text{heat}} Cr^{3+} + CO_2 + H_2O \tag{16.28}$$

Dichromate may be used as an oxidizing agent, and by a redox balance, the amount of oxygen required to oxidize organic compounds can be calculated. This method is faster (order of 3 hours), easier, and less expensive than BOD measurements.

The TOC content of waste-water samples can be determined by using a TOC analyzer. After proper dilutions, samples are injected into a high-temperature (900° to 950°F) furnace and all organic carbon compounds are oxidized to CO_2, which is measured by an infrared analyzer. To determine the TOC content, waste-water samples should be acidified to remove inorganic carbon compounds (mainly carbonates). The total carbon content of waste water can be determined before and after acidification, and the difference is inorganic carbon content.

The nitrogen content of waste-water samples is usually measured by total Kjeldahl nitrogen (TKN) determination. Other key nutrient concentrations, such as phosphate, sulfur, and toxic compounds, should be determined before waste streams are treated.

The concentration of biomass in a waste treatment system using suspended cells is measured as mixed-liquor volatile suspended solids (MLVSS). Basically waste water of known volume is filtered and the collected solids dried and weighed to give mixed-liquor suspended solids (MLSS). This material is then "volatilized" by burning in air at 600°C. The weight of the remaining noncombustible, inorganic material is the "fixed" solids. The difference between the original mass prior to combustion and the fixed solids is the "volatile" portion. The volatile portion or MLVSS is assumed to be primarily microbes, although carbonaceous particles are included in the measurement.