"Sanitation Innovations for Humanitarian Disasters in Urban Areas"

SPEEDY SANITITAZION AND STABILIZATION

APPENDIX 3

FIELD TESTING PARAMETERS

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FIELD TESTING PARAMETERS

COD MEASUREMENT – COLOROMETRIC METHOD

Total COD is the measure of the oxygen equivalent of the organic matter content of a sample by a strong oxidant, potassium dichromate for this experiment. The method followed is standard method 5220 D (APHA, 2012). At lab scale experiment, the COD measurement was carried out as described below. The COD of faecal sludge in the field was made using the Hach Lange High range vials (0-1500 mg O2/L).The two methods work similarly.

The digestion solution (dichromate in concentrated sulphuric acid) oxidizes organic matter to carbon dioxide and dichromate is reduced to chromic ion. The absorbance of the chromic ion is read by the spectrophotometer and fit to a calibration line. For the Hach kit, the COD is displayed on the spectrophotometer (APHA, 2012; Boyles, 1997).

Reagents

The required reagents are digestion solution (10.216 g of $K_2Cr_2O_7$, 167 mL of conc. H_2SO_4 and 33.3 g of $HgSO_4$ added to 500 mL of water), H_2SO_4/Ag_2SO_4 and stock KHP (Potassium Hydrogen phthalate).

i. 2.5 mL of the standard or sample is transferred to a digestion tube and 1.5 mL of digestion solution added.
ii. 3.5 mL of H_2SO_4/Ag_2SO_4 is carefully run down the inside of the tube so that an acid layer is formed. The tubes are capped and swirled several times.
iii. The tubes are placed in a pre-heated oven at 150°C for 2 hours.
iv. The tubes are allowed to cool, the content mixed and the particles allowed to settle.
v. The next day, the contents of each tube are transferred gently to 1cm cell and the absorbance at 600 nm against water is read.
vi. The absorbance of known COD is plotted against the COD concentration to obtain a calibration line.
vii. The absorbance of samples is read and the concentrations determined by using the equation from the calibration line.

TOTAL SOLIDS (TS) AND VOLATILE SOLIDS (VS)

The method is used in the determination of total solids, fixed and volatile fractions of total solids in solid and semi solid samples. It follows method 2540G of the standard method (APHA, 2012).

Reagents

- 100 mL evaporating dish made of porcelain, platinum or high-silica glass.
- Muffle furnace for operation at 550 ± 50°C.
- Steam bath

- desiccator
- Drying oven for operation at 103-105°C
- Analytical balance capable of weighing up to 10 mg

The method followed is described below:

1. The evaporating dish was prepared by igniting clean evaporating dish at 550 ± 50°C for 1 hour, cooling in a desiccator, weighing and keeping it a desiccator ready for use.
2. 25-50 g of sample is placed in a prepared evaporating dish and weighed.
3. The evaporating dish containing the sample was placed in an oven at 103-105°C till all water was evaporated. (It was not possible to use the water bath to evaporate the water to dryness due to the obnoxious smell of the sample). The dish was cooled in a desiccator and weighed.
4. The evaporating dish containing sample was transferred to a muffle furnace heated at 550 ± 50°C for 1 hour. Afterwards, the dish was cooled in a desiccator and weighed.

Calculation

The total solids and volatile solids are calculated from the equations below:

$$\%\, Total\ solids = \frac{(A-B)\times 100}{C-B}$$

$$\%\, Volatile\ solids = \frac{(A-D)\times 100}{A-B}$$

Where A= Weight of dried residue and dish (mg)
B= Weight of empty dish (mg)
C= Weight of wet sample and dish (mg)
D= Weight of ash and dish (mg)

ALKALINITY

This is the acid neutralising capacity of a water sample. Alkalinity is taken as an indication of the concentrations of carbonate, bicarbonate and hydroxide because of its association with the carbonate equilibrium. At pH above 12, carbonate is the only component whereas at pH 8.3, it is bicarbonate and carbon dioxide at pH equal or less than 4.5.

Reagents

- Phenolphthalein indicator
- Metacressol purple indicator
- Methyl orange indicator
- Bromocresolgreen methyl red indicator
- 1N HCl / H_2SO_4 (normal recommended acid is 0.02 N; slightly concentrated acid used because of higher values of alkalinity anticipated.)

The test procedure followed is described below:

1. 25 ml of sample was transferred using a pipette to an erlenmeyer flask.
2. 5 drops of phenolphthalein indicator was added to the sample.
3. Because pH ≤8.3, no red colour appeared. About 5 drops of methyl orange indicator was added and titrated until a red colour appears. The volume of titrant used was recorded.

E. COLI

The enumeration of *E. coli* was carried out using Chromocult Coliform Agar (CCA) from Merck Millipore. The procedure entails dissolving 26.5 g of the agar in 1L of distilled water and heating in a water bath for about 35 minutes. The dissolved agar is cooled to 55°C then dispensed to petri dishes. The petri dishes are inverted once solidified and left to dry for at least four days before use. Once dry, 0.1 mL of sample (or serially diluted sample) is dispensed and spread using a glass spreader in triplicate per dilution. The petri dishes are then aerobically incubated for 24 hours in an upside position at 35± 2°C. Plates containing 30-300 cfu were counted as a viable plate.
Rapid growth of colonies in CCA is facilitated by peptone, pyruvate, sorbitol and phosphate. All bacteria but for total coliform, *E. coli* and some strains of *Salmonella* are inhibited by Tergitol ®7. CCA enables the enumeration of both total coliform and *E. coli* due to the chromogenic substances that are contained therein. The total coliform which is characterized by the enzyme ß-D-galactosidase cleaves the Salmon-GAL substrate and causes a salmon to red colour of the coliform colonies. The main characteristic of coliform bacteria is its ability ß-D-galactosidase to ferment lactose. *E. coli* which has the enzyme ß-D-glucuronidase cleaves to both Salmon-Gal and X-glucuronide forming dark blue to violet colonies (Merck). ß-D-glucuronidase breaks down ß -D-glucopyranosiduronic acids into their corresponding glycons and D-glucuronic acid (Manafi, 1996; Manafi, 2000). CCA has a high specificity in enumeration of *E. coli*.