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THE MONITORING OF SEWAGE TREATMENT PLANTS

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In recent years, more and more sewage treatment plants have been brought into use in the South Pacific territories in an attempt to check the increasing pollution of streams, rivers, lakes and lagoons, used as natural collectors.

Unhappily, such plants need constant monitoring and permanent maintenance. Because there is an acute shortage of trained personnel, it will, in most islands, fall to the lot of public health inspectors to see that plants are working properly.

To help them, and their assistants, in undertaking these important technical duties, a number of simple tests are outlined below. They are easy to perform and make no great demands on the inspectors' time.

1. Methods : Description - log-books - inspections

The inspector must have access to full information about each plant, whence the need for proper records. These should take the form of an up-to-date file, containing a description of the plant, a log-book, and inspection reports.

The description should give full particulars of the plant itself, plus information about the state of affairs up and downstream (population catered for, industrial waste, length and condition of the drainage network, conditions in the receiving water, and so on).

A simple log-book for each plant should be kept by the person in charge, recording any significant events which may have occurred during processing, and the various operations, routine or otherwise, carried out by him.

Inspections, during the first year at least, should be monthly. They can be of three kinds :

Monthly routine inspections with tests;
Quarterly routine inspections with tests and laboratory analyses;
Annual inspections and assessments.

In this circular, we shall deal exclusively with monthly routine inspections and on-the-spot tests to be performed on such occasions by health inspectors.

2. Monthly inspections

The visiting inspector should:

- Scrutinize the log-book and call for any explanations he may deem necessary;
- make a thorough inspection of the plant and equipment;
- make a number of spot checks and comment on the results;
- advise the person in charge of the plant;
- take notes with an eye to an inspection report.

The tests will vary with the type of plant. However, for all types, the treated effluent should be tested for:

- oxidization by potassium permanganate;
- turbidity;
- the presence of mineral nitrogen: NH_4^+, NO_2^-, and NO_3^- ;
- pH;
- dissolved oxygen;
- if chlorine has been used, the presence of residual free chlorine.

Furthermore, if the plant makes use of a trickling filter, the sludge after digestion should be tested for:

- ph;
- colour;
- odour.

In an activated sludge plant, the aeration basin should be tested for:

- ph;
- colour;
- odour;
- settling (30 minutes or possibly 1 hour);
- dissolved O_2;
- examination under the microscope;

on digested sludge:

- anaerobic digestion ..... (pH ;
  (colour;
  (odour;
- aerobic digestion ..... (pH;
  (colour;
  (odour;
  (dissolved O_2
  (examination under the
  (microscope.

Every inspector should possess at least the following scientific equipment:

- One portable oxygen analyser;
- One portable pH meter;
- One microscope;
- One photoelectric colorimeter.

3. <u>The permanganate test</u>:

This test bears on the oxidation of organic matter contained in the treated effluent, when cold, by potassium permanganate in an acid medium. The procedure is as follows:

Rinse flasks with treated effluent and fill with 150 ml of such effluent (up to blue mark). Then to each flask add 10 ml of sulphuric acid to $\frac{1}{4}$ (SO_4H_2 $\frac{1}{4}$). Homogenize.

To the contents of one flask add 3 ml of permanganate ($KMnO_4N$ /80), and to the contents of the other, 6 ml. Homogenize.

Observe for three minutes; if at the end of this period:

- there is no discoloration in the flask containing 3 ml of $KMnO_4$, the test is level 1;
- if there is discoloration in this flask, but none in the flask containing 6 ml, the test is of level 2;
- if there is discoloration in the flask containing 6 ml, try with 9 ml; and
- if after three minutes there is no discoloration in the flask containing 9 ml, the test is of level 3;
- if the contents of the flask containing 9 ml are discoloured, try 12 ml;
- if the 12 ml are not discoloured after three minutes, the test is of level 4;

and

- if the 12 ml are discoloured, the test is of level ≥ 4.

Interpretation

Level 1: the treated effluent is probably of excellent quality.

(95% chances $BOD_5 < 40$ mg/l
(85% chances $BOD_5 < 30$ mg/l

Level 2: quality still acceptable:

(80% chances $BOD_5 < 40$ mg/l
(65% chances $BOD_5 < 30$ mg/l.

Levels above 2 : quality poor.

4. Detecting presence of NH_4, NH_2, and NH_3 :

4.1 NH_4 :

Introduce 50 ml of the water to be tested into a test tube and add 2 ml of Nessler's reagent[1]. Mix; place the tube upright over a white ground and, looking vertically downwards, observe the colour of the liquid. If the ammonia content is high, there will be an orange-yellow or rusty hue or precipitate.

4.2 NO_2 :

Put 20 ml of the water in a test tube and add 1 ml of Zambelli's reagent[2]. Shake. After 15 minutes, add 5 ml of ammonia.

Shake again. If nitrites are present, the water will take on a yellow hue, the more nitrites there are, the more intense this yellow will be.

4.3 NO_3 :

In a test tube, mix 10 ml of treated water with 1 ml of brucine solution. Allow 20 ml of concentrated sulphuric acid (free of nitric acid) to flow down the wall of the tube; then mix thoroughly, shaking with care. Leave for ten minutes. Should the solution have turned yellow, nitrates are present.

The presence of nitrates in treated effluent is usually a sign that trickling filters and prolonged aeration plant have been purifying effectively.

Brucine, being a poison, should be handled with care.

5. Conclusion

In this circular, monthly routine inspections only have been considered; in a later circular, quarterly inspections (with laboratory tests) and annual inspections will be dealt with. A technical circular will also be devoted to the disposal of sludge from sewage treatment plants - an important problem in the Pacific islands.

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Notes

1. Nessler's reagent: Two solutions to be prepared:

   Solution A = 170 g Hg I + 70 g KI, to be dissolved in very little water.

   Solution B = 160 g of caustic soda in 500 ml of water.

   Pour Solution A into Solution B and with distilled water make up to 1,000 ml.

2. Zambelli's reagent:

   Dissolve SO_4H_2 (5 g) with phenol (7.5 g).

   Mix distilled water and Cl H (260 ml) to density 1.19.

   Add ammonium chloride (135 g).

   Make up to one litre with distilled water after dissolution and cooling.

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