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Testing method for effluents from coal preparation plant

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

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In the event of any doubts arising as to the contents,
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Testing method for effluents from coal preparation plant

1 Scope This Japanese Industrial Standard specifies the measurement of a flow rate and the test for properties of effluents discharged from coal preparation plant.

Remarks : The effluents from coal preparation plant contain mine water and effluents from ore accumulation places.

2 General matter

2.1 Reagents, filter papers and tools Reagents, filter papers and tools are as described in JIS K 0050.

2.2 Sample The sample given in this testing method indicates water sampled for carrying out various tests, the test water indicates water fractionally taken for carrying out each test. The test water and the sample shall represent the properties of raw water.

The sample is put into a sample vessel which is cleaned and then sufficiently washed by raw water, filled almost into therein, hermetically sealed, transported to a test room or a test site. For each test, a suitable amount of test water is fractionally sampled from the sample, and quickly tested.

Normative references:

- JIS B 8302 *Measurement methods of pump capacity*
- JIS C 1601 *Indicating thermoelectric thermometers*
- JIS C 1602 *Thermocouples*
- JIS K 0050 *General considerations for chemical analysis*
- JIS K 0102 *Testing methods for industrial wastewater*
- JIS M 8810 *General rules on sampling, analysis and testing of coal and coke*
- JIS M 8811 *Method for sampling and determination of total moisture and adherent moisture of coal and coke*
- JIS R 1306 *Porcelain combustion boats for chemical analysis*
- JIS R 1401 *Non-Metallic protecting tubes for thermocouples*
- JIS R 3503 *Glass apparatus for chemical analysis*
- JIS Z 8401 *Rules for rounding off of numerical values*
- JIS Z 8704 *Electrical methods of temperature measurement*
- JIS Z 8801 *Sieves for testing purposes*
- JIS Z 8802 *Methods for determination of pH*



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2.2.1 Sampling Effluents from coal preparation plant change momentarily their properties by being influenced from variation of operating condition of coal preparation plant, the condition of each machine kind in coal preparation system, and change of the used water amount and the like. Therefore, for the sampling, raw water likely to conform completely to the test purpose by sufficiently understanding the purpose of the sampling test shall be sampled as the sample. For the method for sampling, in order to represent properties of raw water to the best according to each condition, if necessary, the direction and shape of the flow are changed (a head is applied to the flow and the like), and further the sample is taken over several times.

Since the place, time, method and the like of sampling some times are varied according to the purpose of the test, the condition, place, date, time, method, the operating condition of coal preparation plant and the like are clearly described.

2.2.2 Sampling amount The sampling amount shall be as follows.

Screen analysis 10 l or over

Settling test 10 l or over

Other tests 2 l or over

2.2.3 Sample vessel For a sample vessel, a polyethylene bottle or a glass bottle is used.

The sample vessel, in order to prevent mixing of pollutant and the like, is hermetically sealed by the material which is free from generation of contamination and pollution.

For the test vessel, that which is preliminarily sufficiently cleaned, is washed five or more times with raw water, is used.

2.2.4 Transportation and preservation of sample A sample, while properties of raw water are kept, is transported to a test room, and quickly tested. For transportation and preservation of the sample, cares shall be sufficiently taken to prevent damage and deterioration of the sample in the way of transportation and preservation. Cares shall be also taken for the place where it is preserved.

2.2.5 Observation, measurement and recording contents on sampling For observations to be carried out on the site in sampling, recordable items such as the position of a sampling place, date, time, weather (on the day and the previous day) and the like are observed.

Atmospheric temperature and water temperature are accurately measured, and pH also is measured on the site as much as possible.

An outline of other conditions (an odor, a color of suspension and its gross amount, settling state and the like) is recorded by measuring. Further, the operating condition of coal preparation plant on the day is recorded.

2.3 Marking of results

- (1) In the case of marking test results, when two or more test methods exist, either method to be applied is clearly stated.
- (2) Test results shall be generally marked to two significant figures (the third figure is rounded off in accordance with JIS Z 8401) within the determination range.

3 Measurement of flow rate

3.1 Classification of measuring methods The measurement of a flow rate shall be carried out by the following methods.

- (1) Measurement by a vessel
- (2) Measurement by a right triangular weir
- (3) Measurement by a square weir
- (4) Measurement by a breadth weir
- (5) Measurement by a current meter

3.2 Selection of the classification of measuring methods Selection for the classification of measuring methods shall generally be as given in Table 1.

Table 1

Applied range m ³ /min	Classification of measuring methods
Under 1	Measurement by a vessel
Under 4	Measurement by a right triangular weir
≥ 2 to < 8	Measurement by a square weir
≥ 8	Measurement by a breadth weir or measurement by a current meter

3.3 Weir

3.3.1 Structure of weir A weir comprises a channel and a sheathing board.

(1) Channel

- (a) A channel is a wooden groove, and made of several pieces of reinforcing frames assembled in a square, a side face on the inside of the frame, and a sheet lined on a bottom face.
- (b) Though manufacturing dimensions of a channel are determined by the inner size of the channel in **3.3.1 (2) (j)**, the size of square frame and the thickness of a plate and its material are not specified.
- (c) For the channel, the bottom face is horizontal and it shall be solid so that an error in read of a water level is not generated by being deformed by the weight of water flowing in the channel.
- (d) The side face and the bottom face of the channel shall be finished as a plane wherein an inside comes in contact with each other at right angles to be free from leaking water.
- (e) A flow approaching the weir is made uniform, and a wave on the water surface is eliminated, a sieve mesh (an old sieve mesh of a steel sheet of 10 mmø to 25 mmø in sieve division may be used) or an apparatus for straightening a

flow prepared by a suitably perforated plate is provided to an upper stream of the weir. Its position is independently determined.

- (f) The channel of a weir comprises a water level measuring part, flow straightening part and a running water introducing part from the weir to the upper stream (see Fig. 1). The number of perforated plates of the apparatus for straightening the flow is made at least two pieces, as possible four pieces, and installed at a right angle and vertically to the running water at equal intervals in the flow straightening part.

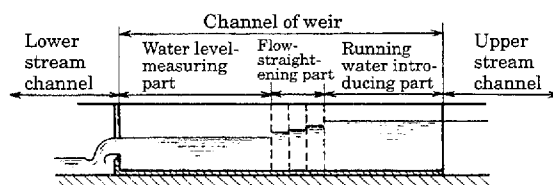


Fig. 1

- (g) The introducing part for running water may be omitted in the case where the channel on the upper stream is larger than the width, depth and the like of the channel. The volume of water kept in store is preferably as much as possible.

(2) Sheathing board

- (a) The material of a sheathing board is a steel plate of ≥ 3 mm thickness.
- (b) The edge of the sheathing board, as given in Fig. 2, forms a plane normal to an inner face of the sheathing board within approximately 2 mm from an inside of the sheathing board, and forms a slant face of approximately 45° toward an outside therefrom.

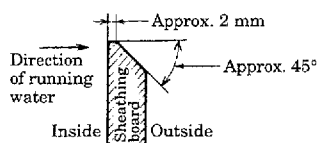


Fig. 2

- (c) The edge inside the sheathing board forms a straight line, and finished by a file to be made the corners sharp and not to have a roundness.
- (d) The inner face of the sheathing board is a plane, and especially the part within 100 mm from the edge is finished as smooth as possible.
- (e) For the sheathing board, so that it is not bent outside by water pressure of running water, a reinforcing material is fitted, as given in Fig. 3, ≥ 3 mm separated from the notch bottom point of the outside face of the sheathing board (right triangular weir) or from the lower edge of the notch (square weir).

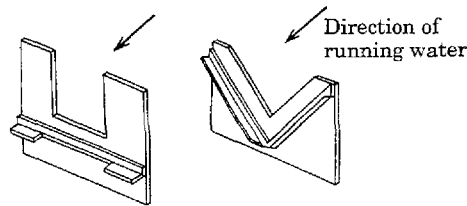


Fig. 3

- (f) The sheathing board is normal to the major axis of a channel, and vertically fixed to the outer frame at the end of the channel so as not to leak water.
- (g) The size of the sheathing board is adjusted to the dimensions of the fitting frame of the channel, and dimensions of the notch is independently determined.
- (h) For the notch of a right triangular weir, the notch angle is 90° as given in Fig. 4, its bisector is vertical and fitted so as to be positioned at the centre of the width of the channel.
- (i) For the notch of a square weir, as given in Fig. 5, the lower edge and both side edges respectively make a right angle. The sheathing board is fitted so that the bisector of the lower edge of the notch is positioned at the centre of the channel and the lower edge of the sheathing board is horizontal and parallel to the bottom face of the channel.

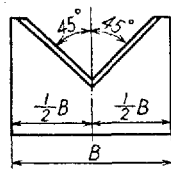


Fig. 4

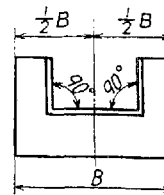
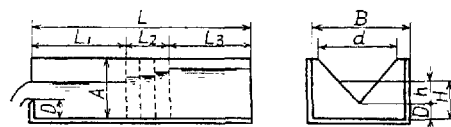


Fig. 5

- (j) The principal dimensions of a right triangular weir and a square weir are for example as follows.

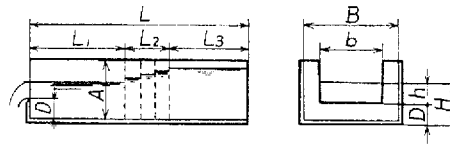
- (i) Right triangular weir



$$\begin{aligned}
 L &= 3.60 \text{ m} & L_1 &\geq 1.35 \text{ m} & L_2 &\approx 0.5 \text{ m} & L_3 &= L - L_1 - L_2 \\
 A &= 0.7 \text{ m} & D &= 0.25 \text{ m} \\
 B &= 0.8 \text{ m} & H &= h + D
 \end{aligned}$$

Fig. 6

(ii) Square weir



$$\begin{array}{llll} L=3.60 \text{ m} & L_1 \geq 2.45 \text{ m} & L_2 \doteq 0.5 \text{ m} & L_3=L-L_1-L_2 \\ A=0.6 \text{ m} & D=0.2 \text{ m} & & \\ B=0.9 \text{ m} & H=h+D & b=0.4 \text{ m} & \end{array}$$

Fig. 7

(iii) Prepared reference figure

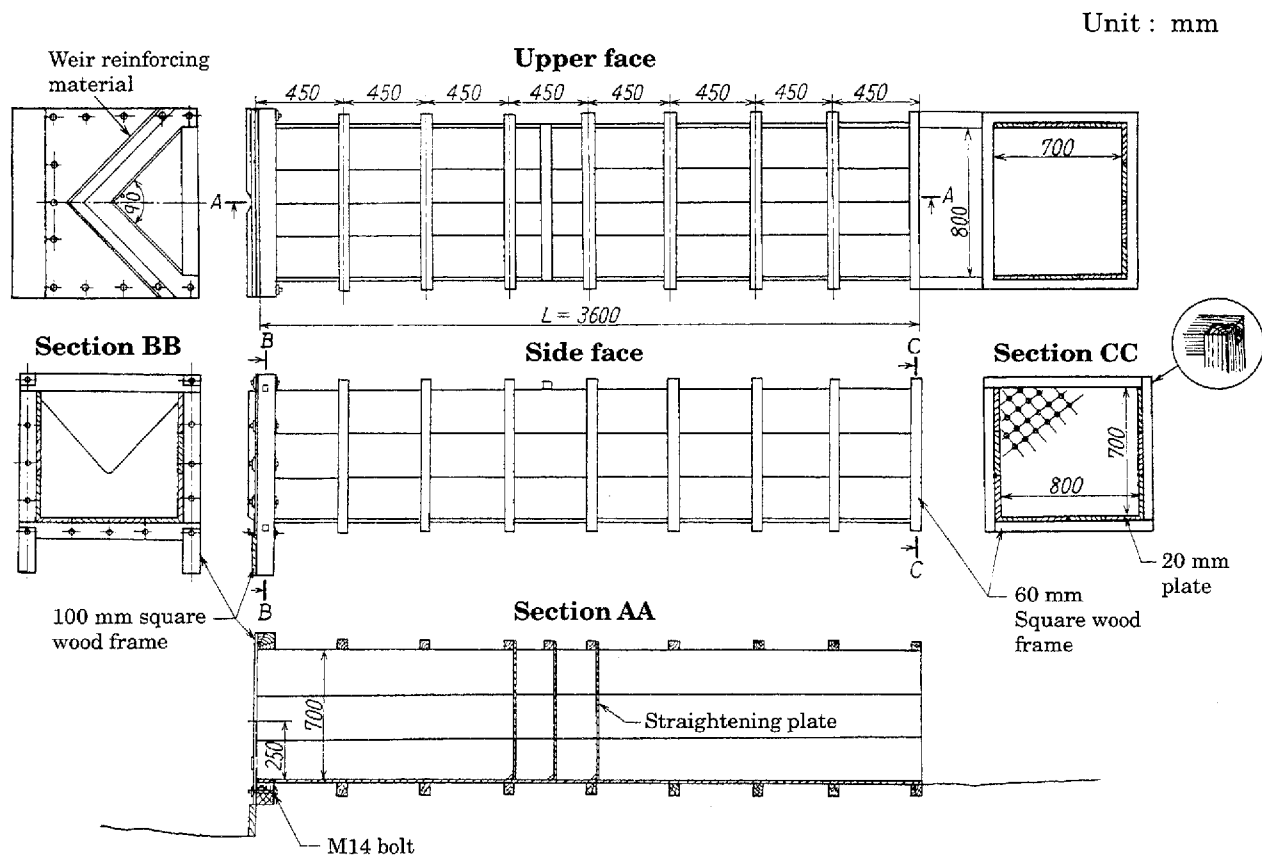


Fig. 8

3.4 Method for measuring head

3.4.1 The head means the vertical distance (h) of a water level at the place for measuring a head on the upper stream side of a weir to the notch bottom point (right triangular weir) or the centre of the notch lower edge (square weir).

3.4.2 The head is preferably measured by the method specified in **2.2** and **2.3** of **JIS B 8302**. However, since installation of the apparatus is often difficult on the job site by the specified method, the measurement is carried out with a measure.

3.4.3 When the head is measured by the measure, the process is as follows.

- (1) The position for measuring the head is 300 mm up stream from the inner face of the sheathing board. In order to indicate the position, suitable metal fittings are fixed to the upper face of a side wall of a channel.
- (2) For the indication metal fittings (Fig. 9), a base line for indicating the measuring position is notched at a right angle in a water running direction on the upper surface, the side surface facing the running water is made acute angled and its ridgeline is made a water level-measuring base line. The crossing point of the indication base line at the measuring position and a water level-measuring base line becomes the point for measuring the head.

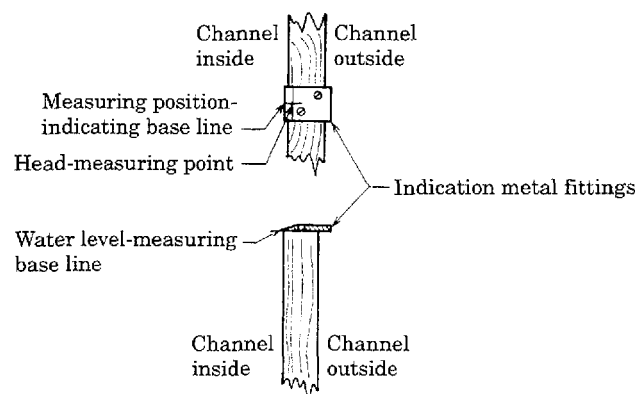


Fig. 9

- (3) The zero point becoming the reference for measuring a head means the point wherein when water in the channel comes in contact with the notch bottom point of a weir (right triangular weir) or the center of the notch lower edge (square weir), the water surface comes in contact with a line lowered vertically from the head-measuring point of the indication metal fittings at the measuring position. Its vertical distance (a in Fig. 10) is measured in mm unit to be made the measured value for the zero point water level.
- (4) For measuring a water level in measuring a flow rate, the vertical distance (b in Fig. 10) between the water level-measuring point in the same way as that in measuring the zero point and the water surface of flow is measured in mm unit to be made the water level measured value of a flow.

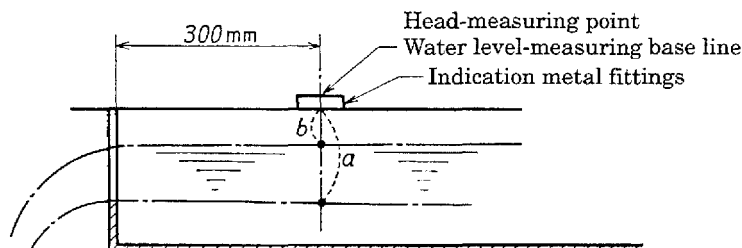


Fig. 10

- (5) A head measuring value as the basis for calculating a flow rate is $a - b$ i.e.
 [a measured value for a zero point water level (mm)
 – a measured value for water level of flow (mm)
 = measured head (mm)]
- (6) Though the water level of a flow must be necessarily measured in measuring a flow rate, the zero point water level, if once measured before start of investigating the flow rate, is not necessarily carried out each measurement of a flow rate. However, since the channel is changed if any movement exists, the measurement is carried out as occasion demands even in the investigation period.
- (7) Measurement of a head is carried out in a state wherein water flowing down by going beyond the weir is not stuck to the outside of the sheathing board.

3.5 Method for calculating flow rate The flow rate of effluents from coal preparation plant is calculated from the following formula. In the case where as the method for measuring effluents from coal preparation plant, measurement is carried out by preparing the specified channel and a sheathing board beforehand determined, a measured flow rate may be adopted by using the graph given in Fig. 11.

3.5.1 Right triangular weir

$$Q = Kh^{5/2}$$

where, Q : flow rate (m³/min)
 K : flow rate coefficient

$$K = 81.2 + \frac{0.24}{h} + \left(8.4 + \frac{12}{\sqrt{D}}\right) \left(\frac{h}{B} - 0.09\right)^2$$

D : height from bottom surface of channel to notch bottom point (m)

B : width of channel (m)

h : head of weir (m)

Applied range of the formula shall be as follows.

$$B = 0.5 \text{ m to } 1.2 \text{ m} \quad D = 0.1 \text{ m to } 0.75 \text{ m}$$

$$h = 0.07 \text{ m to } 0.26 \text{ m} < B/3$$

In the case where the apparatus is manufactured as given in dimensions of **3.3.1 (2) (j) (i)** Fig. 6, since the relation between the measuring head and the flow rate is given in the graph, the flow rate to the measured head is read in significant two digits from this graph, and it is sufficed to adopt it as the measured flow rate.

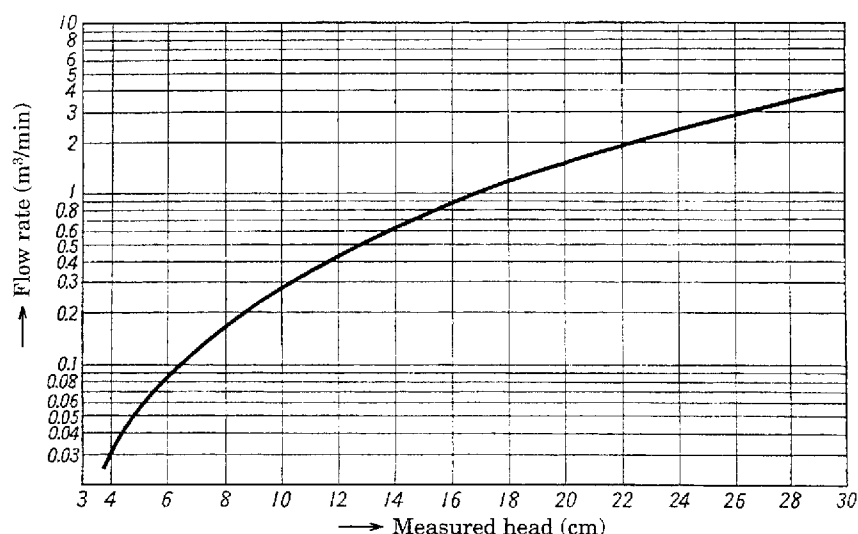


Fig. 11 Measured head and flow rate of right triangular weir
(in the case of a weir of $B = 0.8$ m and $D = 0.25$ m)

3.5.2 Square weir

$$Q = Kb h^{3/2}$$

where, Q : flow rate (m^3/min)
 b : width of notch (m)
 h : head of weir (m)
 K : flow rate coefficient

$$K = 107.1 + \frac{0.177}{h} + 14.2 \frac{h}{D} - 25.7 \sqrt{\frac{(B-b)h}{DB}} + 2.04 \sqrt{\frac{B}{D}}$$

D : height from bottom surface of channel to lower edge of notch (m)

B : width of channel (m)

Application range of this formula is as follows.

$$B = 0.5 \text{ m to } 6.3 \text{ m} \quad b = 0.15 \text{ m to } 5 \text{ m}$$

$$D = 0.15 \text{ m to } 3.5 \text{ m}$$

$$\frac{bD}{B^2} = 0.06 \text{ or over}$$

$$h = 0.03 \text{ m to } 0.45 \sqrt{b} \text{ m}$$

In the case where the apparatus is prepared as given in 3.3.1 (2) (j) (ii) Fig. 7, the relation between measured head and flow rate is given by the graph in Fig. 12, the flow rate to the measured head is read by 2 digits in significant figure from the graph, which suffices for being read as the measured flow rate.

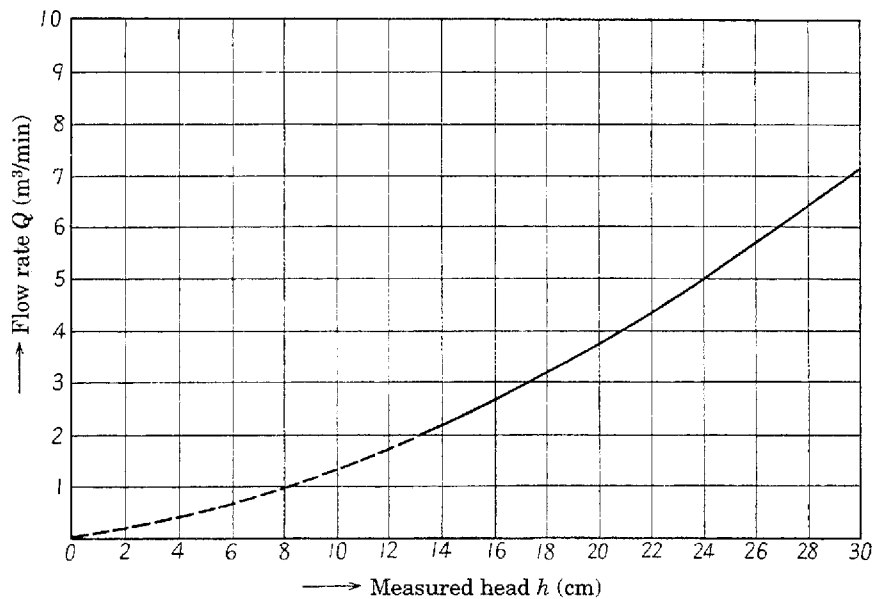


Fig. 12 Measured head and flow rate of square weir
(as given in the formula for square weir in 3.5.2. Where $b = 0.4$ m,
 $B = 0.9$ m, $D = 0.2$ m)

3.5.3 Breadth weir

$$Q = KBh^{3/2}$$

where, Q : flow rate (m³/min)

B : width of weir (m)

h : head of weir (m)

K : flow rate coefficient

$$= 107.1 + \left(\frac{0.177}{h} + 14.2 \frac{h}{D} \right) (1 + \varepsilon)$$

D : height from bottom surface of channel to the edge of weir (m)

ε : correction item

when $D \leq 1$ m $\varepsilon = 0$

$D \geq 1$ m $\varepsilon = 0.55 (D - 1)$

The application range for this formula is as follows.

$B \geq 0.5$ m $D = 0.3$ m to 2.5 m

$h = 0.03$ m to D m (where $h \leq 0.8$ m) $h \leq B/4$

3.6 Measuring conditions for flow rate and arrangement and marking of measured value

3.6.1 When the flow rate of effluents from coal preparation plant is examined, a day wherein there is as little abnormality as possible in treating amount, operation time, facilities and the operation state for the operation in coal preparation plant is selected, and for an examination unit at least one operation day is taken as one unit.

3.6.2 On the examination day, from start time of operation on the day, measurement of the amount of effluents from coal preparation plant is carried out necessarily at specific intervals, as a rule, every 10 min or 15 min, the measurement is continued until the operation on the day is ended and the operation on the following day starts or until discharge of effluents from coal preparation plant ends while from the end of the operation on the day to start of the following operation.

Remarks : In the case where there is no change in flow rate, the above-mentioned time intervals may be suitably prolonged.

3.6.3 For the measured value of flow rate measured at equal intervals in one examination unit,

- (1) The relation between the operation time and the flow rate is displayed on the graph.
- (2) An arithmetic average value of the measured values is calculated as the average flow rate.
- (3) The maximum value of measured values is made the measured value for the maximum flow rate.

The amount of effluents from coal preparation plant is indicated by the above-mentioned three terms.

3.6.4 In the case where an abnormality exists in the operation of coal preparation plant or others during continuation of measurement, significant change exists in the flow rate of effluents from coal preparation plant, and the measured value is influenced thereby, a retest is carried out.

Remarks 1 **Other methods for measuring flow rate** In the case where the right triangular weir and the square weir which are specified as the methods for measuring the flow rate of effluents from coal preparation plant cannot entirely be installed owing to unavoidable circumstances on the job site, the following shall apply.

1.1 Measurement by vessel

1.1.1 In the case of the maximum flow rate of $< 1 \text{ m}^3/\text{min}$

- (1) At an over-flow opening of running water or a flow out position having a head, the measurement is carried out by receiving running water by a vessel.
- (2) A time required for filling running water into a vessel of 100 l to 200 l in capacity is measured by a stopwatch. The volume is determined so that the time for receiving the liquid becomes 20 s or over.
- (3) The flow rate is obtained by the following formula.

$$Q = 60 \frac{V}{t}$$

where, Q : flow rate (m^3/min)

V : volume of vessel for measurement (m^3)

t : time required for filling the volume V by the flow rate (s)