Studies on the Grading of Sand by means of Sieve Analysis

Conclusive Remarks

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ふるい分析による砂の粒度に関する研究

要　　約

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1. The purpose of these studies is to establish such methods of the investigation, presentation and utilization of grading that answer the practical purposes of obtaining final manifold results from the same field sample through mechanical analysis.

The established methods have been applied to the sediment in Sakai Channel.

2. The studies were limited to the grading of sand (coarse-grained soil) by the sieve analysis, for the following reasons:

(1) The sediment in Sakai Channel used in the studies is mainly composed of nonconcreted sand grains.

(2) The mechanical analysis of coarse-grained soil is generally recognized as significant.

(3) Various objectionable points which arise from the different principles of the mechanical analysis between coarse-grained and fine-grained soils can be neglected.

(4) The standard method of the mechanical analysis of coarse-grained soil is sieve analysis.

3. The object of sieve analysis is to obtain the unique grading of esch sand sample.

The grain size of natural sand can be regarded as continuous. Sieve analysis, therefore, corresponds to a statistical operation of searching for the grading (grain-size frequency distribution).

4. The grade limits (sieve openings) in sieve analysis can be set up arbitrarily, and therefore should distinctly be distinguished from the group divisions (descriptive limits) of sand grains.

5. In the conventional procedure in statistics, when a frequency distribution is searchcd for, class intervals are generally set equal. In case of sieve analysis it is desirable that the grade limits are geometrical, for grain-size accumulation curves are usually drawn by using the logarithm of grain sizes as an independent variable, and, in calculating statistical measures by moment method, the calculation can be made with ease.

It is suitable to use $2^{1/8}$ scale (a scale of geometrical series that has both the common ratio $2^{1/8}$ and the term 2) as the grade scale (fundamental scale of grade limits).

6. In sieve analysis, the choice of sieve openings is the most important. The openings should correspond to the grading that the worker expects to obtain or to the measures on the grading in question. It is desirable that the openings form a geomtrical series.

7. Sieve analysis should be simple and speedy within the limit of the allowable error. Therefore, the procedures of sieve analysis were experimentally examined.

8. The following three errors are involved in sieve analysis:

(1) splitting error;

(2) classifying error (error due to the choice of grade limits);

(3) sieving error.

They were experimentally examind. Out of these, classifying error is especially to be attended to.

9. For whatever purposes the results of sieve analysis may be used, it is necessary to analyse under the same condition, as sieve analysis is in a sense a comparison of grading, and personal errors should be minimized.

10. The final results of sieve analysis can be classified into three types: statistical measures, measures of soil properties, and grain-size accumulation curves.

11. The characteristics or particular values of the unique grading were defined as measures concerning grading, and were classified from three different standpoints:

(1) statistical measures and measures of soil properties;

(2) arithmetical, geometrical and logarithmic measures;

(3) analytical and graphical measures.

12. Statistical measures signify characteristics of grading which correspond to characteristics of frequency distribution in statistics.

From the results of the analyses by means of statistical measures of the grading of the sediment in Sakai Channel, it has been found that the graphical moment measures (graphical measures based on approximate graphical analogies to moment measures) and moment measures have a high correlation on central tendency and dispersion respectively.

In other words, the above-mentioned graphical measures have an accuracy nearly as much as moment measures. Thus it can be said that the former are practically more useful than the latter, since the former are obtained more easily and rapidly.

13. Measures of soil properties signify those particular values of the grading that are highly correlated with soil properties.

They involve both the results of experiments which have been made by many workers and the criterion of designs on grading based on theory and experience. Many of the measures are put to practical use.

14. Grain-size accumulation curve graphically yields statistical measures and maesures of soil properties and besides, it deserves special emphasis that the comparison of grading by means of visual inspection has an unexpectedly wide range of use.

In view of these facts, it was attempted to standardize the way of presenting grading in the accumulation curve.

15. Thus, the object to be attained in sieve analysis becomes very clear, so that needless procedures can be avoided. It may be the accumulation curve itself, or a particular measure

on the grading.

If the analysis is made, for example, for the purpose of obtaining 50 per cent diameter (median), it is sufficient to use such a method as to analyse only the grading near the cumulative frequency 50 per cent.

16. The sediment in Sakai Channel is closely connected with the impoldering and coffering project of Nakaumi Lake in the following respects:

(1) sand running-down and littoral sand;

(2) the dredging of the channel in order to promote the function of letting the water run, and the utilization of the dredged soil as the material for the sea dike and for filling-up.

Statistical measures are to be used in the discussion of (1); measures of soil properties in (2); and grain-size accumulation curves in both of them.

17. As an example of analytical researches on the grading, the sieving data of the sediment in Sakai Channel were analysed by using statistical measures.

From the results of the analyses, it can be reasoned that the stream of water and the sediment transportation in the channel are stable on the whole, but they are most unstable about the estuary of the channel and considerably unstable in its middle part.

The cause of the instability is due to the breakwater about the estuary and to the reduction of the sectional area in the middle part of the channel.

Some of these studies were (or are to be) published in the following reports:

1. MATSUURA, Y.: Choice of Sieves for classifying Sand, Trans. Agr. Eng. Soc., Japan, No.4, 1—5, 1962

2. ——— : On the Errors in Sieve Analysis of Sand, Bull. Shimane Agr. Coll. No.10, A, 74—78, 1962

3. ——— : Presentation of the Grading of Sand by means of Grain-size Accumulation Curves, Mimeographed, 1961

4. ——— : Measures on the Grading of Sand, Mimeographed, 1961

5. ——— : Statistical Measures on the Grading of Sand, Soil Mech. Found. Eng., No.52, 3—8, 1962

6. ——— : On the Distributions of the Grading of the Sediment in Sakai Channel, 1961

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摘　　要

研究対象を砂に限定して，応用面においては異なった目的をもつ場合の，粒度の調査・利用の方法を確立し，これを境水道（海）底上に応用した。