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DEVELOPMENT AND STANDARDIZATION OF A RAPID TEST METHOD FOR INDENTIFICATION OF THE ALKALI REACTIVITY OF AGGREGATES

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1. INTRODUCTION

In Japan, both of the chemical method and the mortar-bar method were established as the JIS methods [1] by referencing the ASTM methods in 1986. However, the chemical method requires skilled chemical engineers and high-priced testing equipments, and on the other hand, the mortar-bar method needs a long time of 6 months. Judging from these circumstances, for a daily quality control of concrete aggregates, the development and standardization of a new rapid test method was considered essential.

This report describes on the outline of the research in which a new rapid test method for indentification of the alkali reactivity of aggregates has been developed and standardized. This research has been carried out in the committee held by National Ready Mixed Concrete Industry Association sponsored by Agancy of Industrial Science and Technology in the Ministry of International Trade and Industry from fiscal 1986 to 1988.

2. PROCEDURES FOR DEVEROPMENT AND STANDARDIZATION

The investigations were carried out in accordance with the procedure shown in Fig.1. Aggregate samples were gathered from 59 sites as crushed coarse aggregates, taking account of the petrographic variety, as well as the geological variety in Japan. Alkali reactivity of the sample aggregates were evaluated by the JIS chemical method, the JIS mortar-bar method and a rapid method, respectively. Out of several kinds of rapid methods already proposed, the GBRC Rapid Method [2] developed by General Building Research Corporation was selected as the rapid method for this investigation.

Relationships among the test results by the rapid method, by the JIS chemical method and by the JIS mortar-bar method were investigated. The pressure (temperatrue) and time

of boiling for acceleration of alkali-aggregate reaction were decided so that the follow--ing two conditions shoud be satisfied.

(1) Innocuous aggregates identified by the JIS chemical method are evaluated innocuous by the rapid method.

(2) Deleterious aggregates identified by the JIS mortar-bar method are evaluated deleter--ious.

Other test conditions such as the ratio of sample aggregate to total aggregate, the particle size destribution of sample aggregate and the moisture condition of aggregate were also investigated.

According to the investigations, a draft of the rapid test method were accomplished. The flow chart of the rapid test method is illustrated in Fig.2. The outline of the rapid test method is described as follows. Three mortar bars of 4×4×16 cm are made with 600g of crushied particles of sample aggregate, 600g of innocuous standard sand (Toyora sand;JIS R 5201,9.2), 600g of ordinery portland cement and 300g of NaOH solution NaOH solution is used so that the alkali content of the cement used in the mortar is adjusted to 2.5 % Na_2O equiv.. After the specimens are cured in the molds in a moist cabinet at (20±3)℃ for the first day, and in water at (20±3)℃ for the second day, they are then placed in boiling water in a pressure vessel (gauge-pressure: 1.5 kg/cm², temperature: 127℃) for 4 hours. An automatic pressure vessel for the rapid test were newly designed and produced.

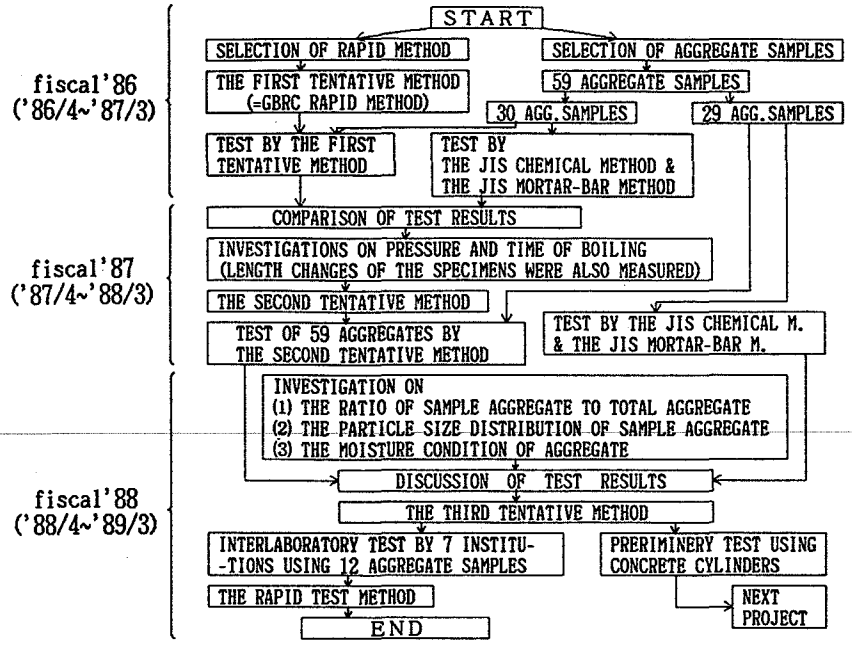

Fig.1 Procedures of development and standardization of a rapid test method

Alkali reactivity of an aggregate can be evaluated by any one of they following three items such as ultrasonic pulse velocity, relative dynamic modulus of elasticity and length change. Innocous aggregates satisfy any one of the following three items:

(1) An ultrasonic pulse velocity ratio of more than 95.0%.

(2) A relative dynamic modulus of elasticity of more than 85.0%.

(3) A length change of less than 0.100%.

As a final check of the rapid test method, an interlaboratory test by 7 institutions using 12 aggregate samples has just started since the end of February 1989. A prelimi-nary test for a rapid identification of the future susceptibility of alkali-aggregate reaction in fresh concrete was also carried out by using a similar technique for the next project.

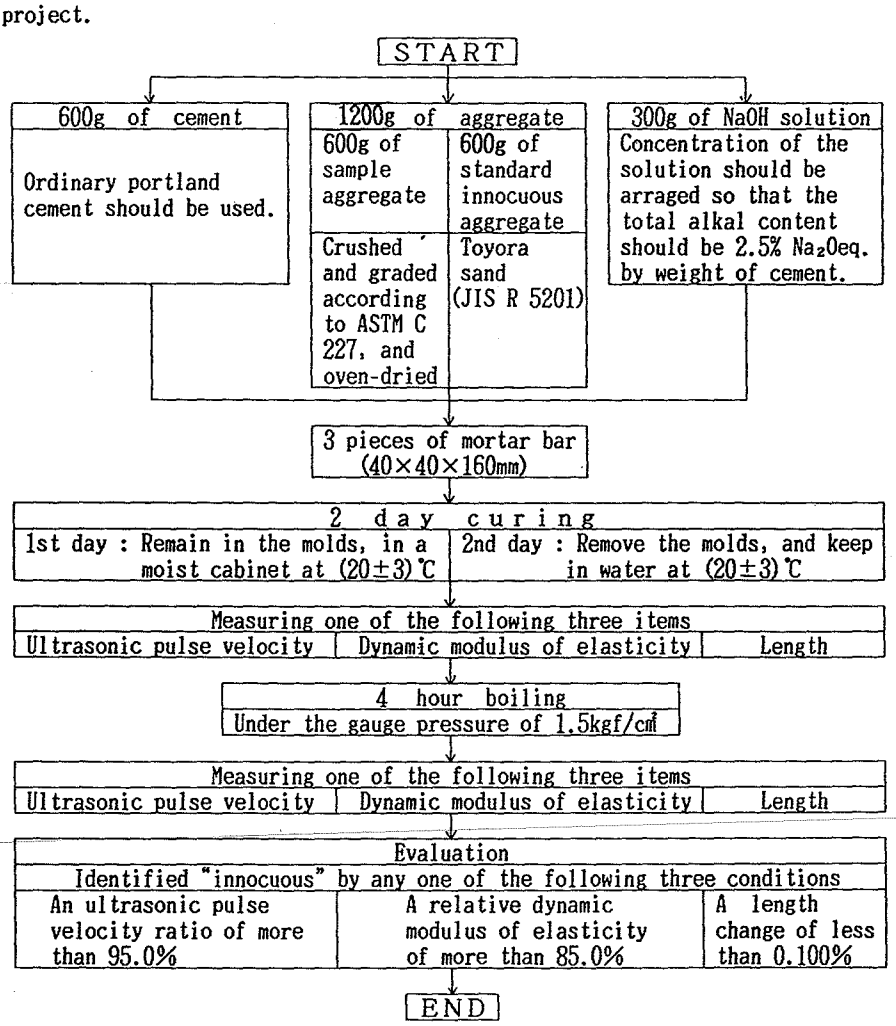

Fig.2 Flow of the rapid test method

3. EXPERIMENTAL RESULTS AND DISCUSSION

Comparison of the results by the JIS chemical method with ones by the JIS mortar-bar method is illustrated in Fig.3. Comparisons of the results by the rapid test with ones by the JIS chemical method are expressed in Fig.4.1~4.3. In each figure, both results with and without standerd sand are shown, using ultrasonic pulse velocity ratio, relative dynamic modulus of elasticity and length change, respectively. Relationships among the test results of three items for identifying the alkali reactivity of aggregates are shown in Fig.5. Judging from those figures, the followings can be drawn.

(1) Evaluation by the rapid test without standard sand is too strict, evaluation by the test with standerd sand is appropriate.

(2) All of three items for evaluating the alkali reactivity of aggregates are available and well related with each other.

4. CONCLUSION

A new rapid test method investigated in this committee was roughly introduced. This method will be establishied at the end of fiscal 1988. More information about this rapid test method will be described in the final report published in the near future.

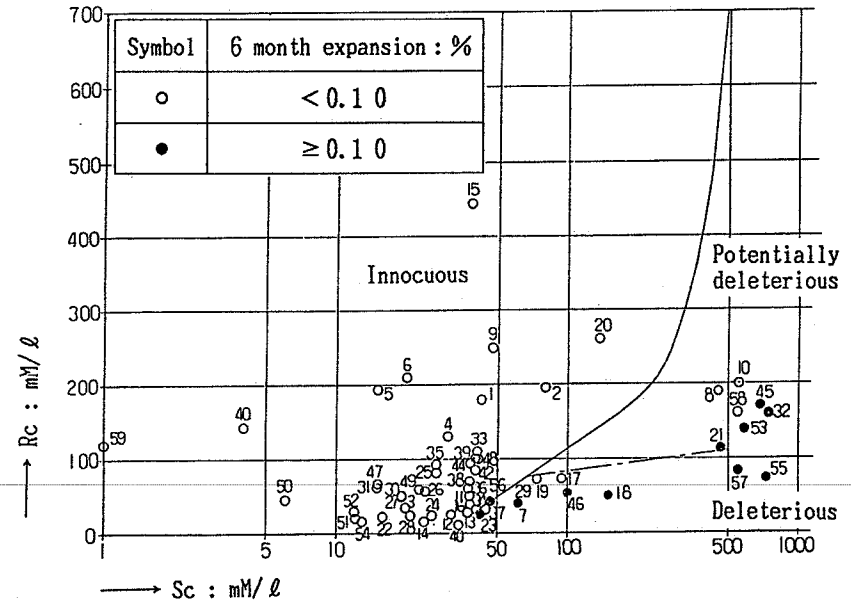

Fig.3 Comparison of results by the JIS chemical test with results of ones by the JIS mortar-bar expansion test

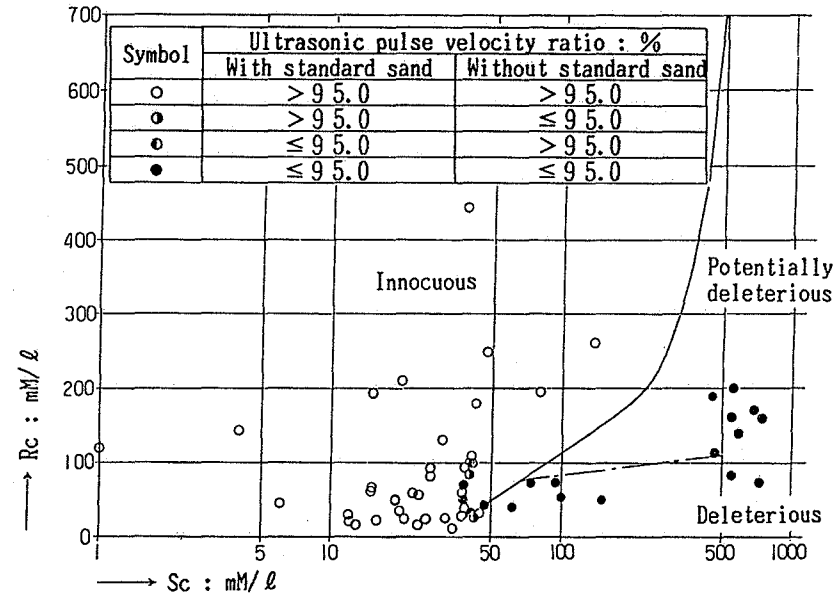

Fig.4.1 Comparison of results by the JIS chemical test with both results of the rapid test with and without standard sand, using ultrasonic pulse velocity ratio

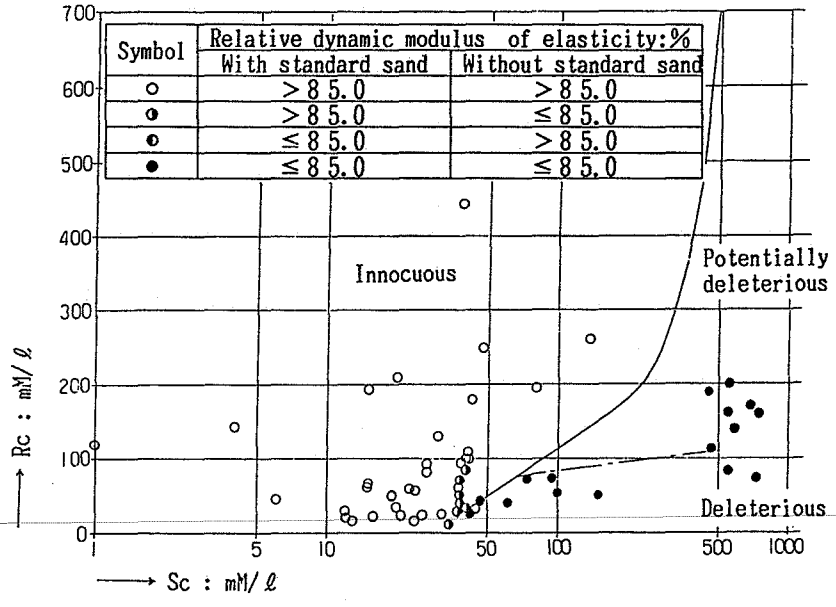

Fig.4.2 Comparison of results by the JIS chemical test with both results of the rapid test with and without standard sand, using relative dynamic modulus of elasticity

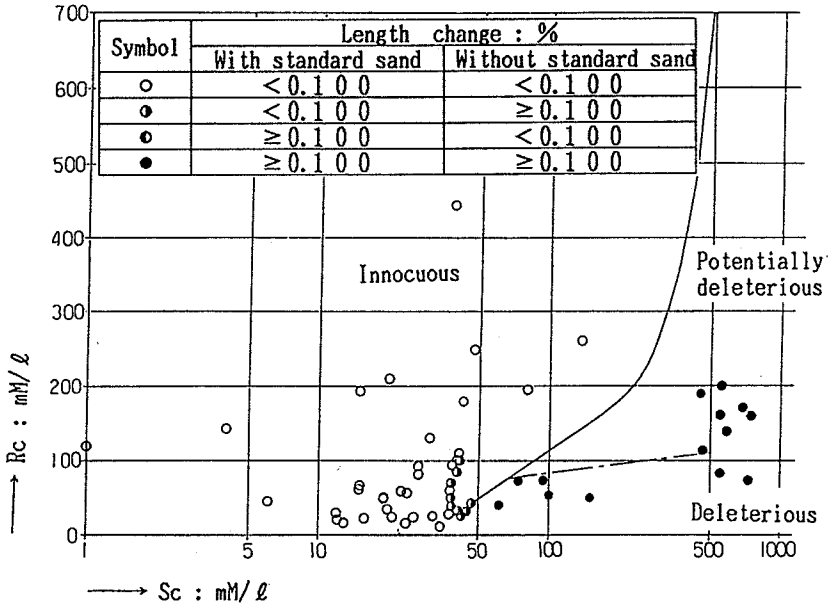

Fig.4.3 Comparison of results by the JIS chemical test with both results of the rapid test with and without standard sand, using length change

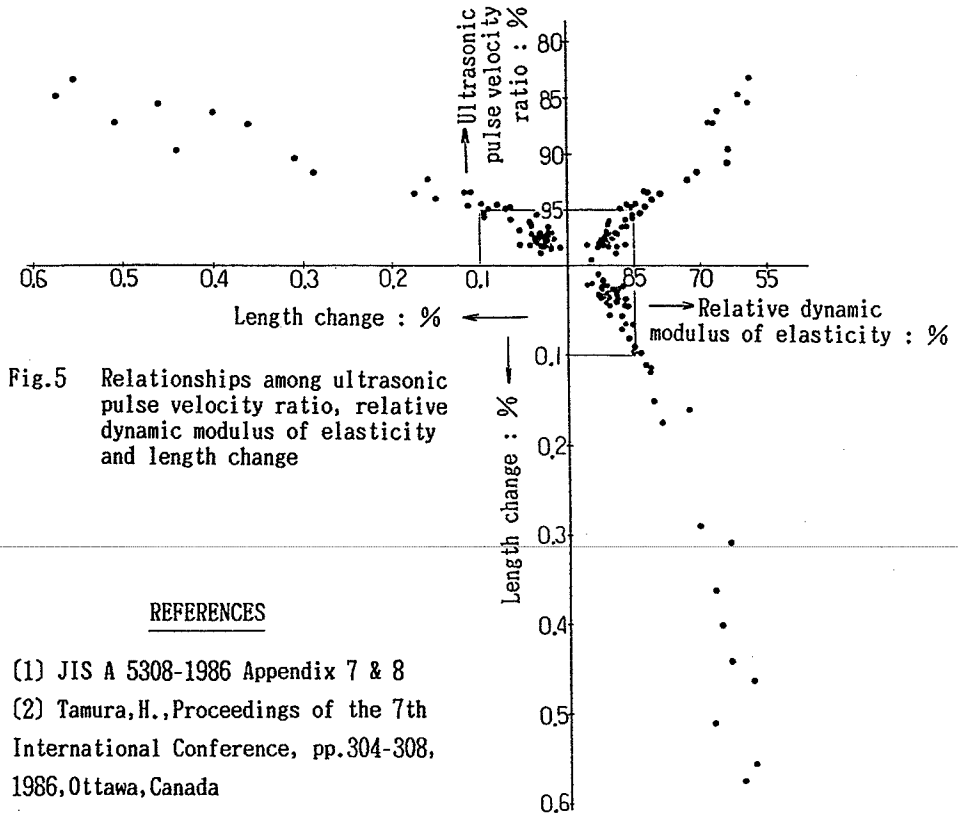

Fig.5 Relationships among ultrasonic pulse velocity ratio, relative dynamic modulus of elasticity and length change

REFERENCES

(1) JIS A 5308-1986 Appendix 7 & 8

(2) Tamura, H., Proceedings of the 7th International Conference, pp.304-308, 1986, Ottawa, Canada