Student Voice

Ms. Biruktawit Taye (The University of Tokyo)

My name is Biruktawit Taye. Currently, I am a second-year Masters student in the Civil Engineering department at the University of Tokyo. Japan, a technologically advanced country that has preserved its customs and traditions, has been my home since October 2013. I thank the JSCE editorial committee for offering me this chance to write about my experiences in Japan.

I arrived in Tokyo on the first day of October 2013. From the beginning, I received very warm and continuous help from my tutor and the other members of my laboratory. I find the life of Kishi-Nagai laboratory quite interesting because everyone always something for me to learn. Each instructor and student has their own strength and way of thinking. Knowing that and working with them helps push me to constantly improve myself. The laboratory members are more than just lab partners. The periodic research/lunch meetings provide us with useful comments and questions from our supervisors and students to further shape our research. In addition to their own research-related tasks, every student helps the other in their day-to-day activities and during experiments and concrete casting. Like a close family, we also discuss issues related to our daily lives and future plans. We also participate as a team in annual concrete canoe competitions and take winter/summer trips together. These are some of the exciting experiences I have had at the lab.

The challenges of civil engineering are immense, and we cannot know everything through course work at universities. Experience contributes much to balance our wisdom, and the challenges always require us to continually update ourselves about recent research achievements. I am grateful for the opportunity to participate in informative seminars, such as the annual Civil Engineering Symposium at the University of Tokyo and the Shinkansen seminar organized by Japan Railway Technical Service, JR-East & JR-Central, and the 100th Anniversary of JSCE. The JSCE workshop, “International Workshop for Young Civil Engineers” challenged us to solve the needs of the society by thinking beyond our technical knowledge. I hope that I will have more opportunities to participate in workshops, learn different skills, and visit various infrastructures.

In addition to formal school life, the University of Tokyo is a place where I can meet people from different backgrounds and learn about many cultures. Students from every continent join the graduate programs, work with each other, and become life-long friends. Moreover, the Alumni association hosts international students in its Host-Family Program. I am lucky to have Mr. Hiroshi Okada, a very experienced civil engineer, and his family as my host family. I had the chance to celebrate the New Year with the Okada family and learn a lot about Japanese customs. I was also quite surprised to meet a group of Japanese people studying Ethiopian dance and language, as well as promoting Ethiopian culture and art here in Japan. Indeed, Tokyo is a city where I can enjoy both an international environment and distinctive Japanese traditions throughout the year.

To conclude, I would like to introduce some of my current research.

Christmas 2013 at student room

Visiting Kamakura with Okada-family

Lab trip in Yamanashi prefecture

With members of Mocha Ethiopia Dance Group

RECYCLING CONCRETE WASTE MATERIALS USING COMPACTION

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ABSTRACT

Large amounts of waste concrete are produced in developed countries by disasters and the demolition of old structures. Currently, waste concrete is mainly recycled as a base course material for road construction. Developed countries, however, are expected to construct fewer roads in the future. Previous research has shown that a chemical bond forms in hardened cement paste powder upon compaction, resulting in mechanical performance that is similar to that of the original paste. This study examined the formation of these chemical bonds to determine if an alternative means could be developed for recycling old concrete. Experiments showed that the bond is more dependent on the size of concrete powder than on the original water to cement ratio.

1. INTRODUCTION

Concrete is the most common construction material and it can last a long time. However, it deteriorates over time for numerous reasons and needs regular maintenance and eventual replacement. This study investigated the utilization of concrete powder compaction as an alternative means of recycling concrete. Soroka and Sereda (1970) pointed out that solid-to-solid contact of surfaces resulting from the compaction of hydrated cement paste powder formed inter-particle bonds. Powder compression, on the other hand, has long been the dominant technique in the pharmaceutical industry for forming tablets and is equally essential for powder metallurgy and structural ceramics production.

2. EXPERIMENTAL APPROACH

Concrete samples were dried in a 40^{0}C chamber for 48 hours, manually reduced to a maximum particle size of 10 mm, and ground to a finer size using a mechanical-jaw crusher and a grinder.

The prepared powders were then pressed using the wet bag method in an isostatic pressing machine (Fig. 1(a)). This recycling method was selected because the pressure is applied uniformly to all of the outer surfaces of the forming mold, resulting in highly uniform consolidation. In this method, the concrete powder is poured into 1-cm cubic silicon molds and sealed airtight using plastic film (Fig. 1(b)). The sealed mold is then immersed for 3 minutes in a high-pressure vessel containing water as the compression medium.

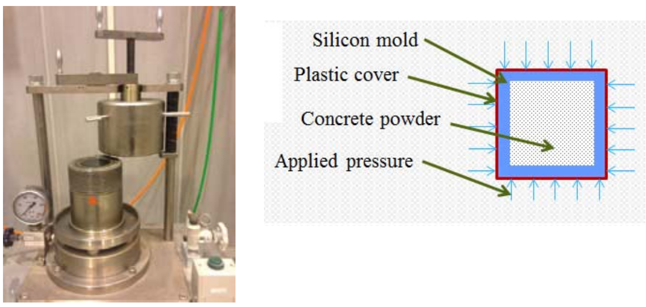

Figure 1. (a) Isostatic pressure machine; (b) Air-tight silicon mold

3. RESULT AND DISCUSSION

Figure 2 compares the average compressive strengths and the maximum concrete power particle sizes of concrete samples with three water-cement (w/c) ratios and compacted with a compression force of 200 MPa.

The compressive strength growth trends of the different water cement ratios were similar, rising more rapidly as the maximum particle size became smaller than 600 µm. As the maximum size of the concrete powder particles decreased from 1180 µm to 600 µm, the average strength of the compacted concrete samples with three different water-to-cement ratios increased by an average of 2 MPa. A further reduction in the maximum concrete powder particle size to 101.5 µm resulted in a relatively higher average compressive strength gain of 17 MPa. However, the average difference between the strengths of the 40% and the 70% w/c specimens of different particle sizes was only 4 MPa. The increased concrete strength of the finer powder particles is probably due to the increase in attainable interparticulate bond resulting from greater surface area.

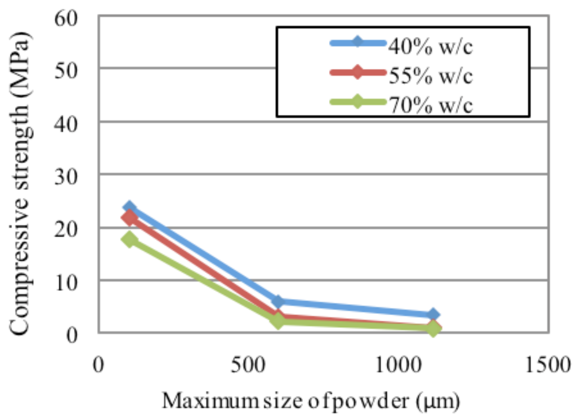

Figure 2. Compressive strengths of concrete samples with 40%, 55%, and 70% w/c compacted with a 200 MPa compression force.

4. CONCLUSION

The compressive strength of the recycled concrete specimens prepared using powder compaction was significantly affected by the particle size of the concrete powder. The variation in the water cement ratio, however, had relatively little effect on the compressive strength.

REFERENCES

I. Soroka, P.J. Sereda. The structure of cement stone and the use of compacts as structural models. Proc. 5th Int. Symp. on the Chemistry of Cement, Tokyo (1968), pp. 67–73 Part III