JSCE Committee on Development of “Environment - Harmonized Concrete Material Science and Engineering”

This committee was established under the Concrete Committee of the Japan Society of Civil Engineers (JSCE) and was active during 2009-2011. The committee chair was Hidenori Hamada, professor of Kyushu University.

The background to establishment of the committee was the growing public concern over global environmental issues, leading to environmental preservation measures being urged on the construction and concrete industries. The key response to this issue is to make steady progress with the development of low-environmental-impact concrete technology and the establishment of a supply chain for low-environmental-impact concrete. Committee discussions revolved around what materials could contribute to this response and what systems can be put in place to supply them.

Looking at low-environmental-impact concrete material science and engineering, discussion first focused on the current state of the cement and recycled aggregate industries and the problems with them. The cement industry makes use of a huge volume of waste products and byproducts, accounting for 45% of all raw materials. The manufacture of cement in Japan is, in this sense, the most efficient in the world. A future hope of the cement industry is that international contribution through technology transfer should be promoted.

Recycled aggregate has a lower environmental impact' than ordinary aggregate. However, its quality is inferior and its use results in greater CO_2 emissions. As this example indicates, it is difficult but important to balance the cost, quality, and environmental impact of any technology. It is concluded that an integrated system of quality, policy, production, and distribution should be developed.

One of the keywords in discussions of systems for manufacturing low-environmental-impact concrete is “green procurement,” reflecting the importance of taking environmental impacts into consideration in the purchase and procurement of concrete. The problems to be solved are developing a rational evaluation method based on two or more evaluation vectors and the establishment of a means of assuring

performance. Discussions among committee members also focused on the importance of extending service life as a way to reduce the environmental impact of concrete structures.

As a result of the committee's discussions, an outline of low-environmental-impact concrete was developed as follows.

1) Environment-harmonized concrete is defined as concrete consisting of materials that have a minimal impact on the environment. According to this definition, low-environmental-impact concrete is a concrete using the maximum possible proportion of wastes and byproducts. The definition also includes the meaning that at least two other factors, the energy consumed in transportation and CO_2 emissions, are reduced to a minimum.

2) To evaluate "minimal impact on the environment," a quantitative evaluation index is necessary. An environmental harmonization index "**I**" is developed for low-environmental-impact concrete involving the factors "$\mathbf{I_G}$" for CO_2 emission index, "$\mathbf{I_W}$" for recycling ratio, and "$\mathbf{I_L}$" for the local material utilization index. These factors are given by the following equations:

$\mathbf{I_L} = 1 - (\text{production and shipping distance (km)} - 50) \div 1{,}000$

$\mathbf{I_G} = (\text{ratio by which } CO_2 \text{ emissions are reduced if used (\%)} \div 25$

$\mathbf{I_W}$ = (quantity of recycled resources) ÷ (quantity of virgin resources + quantity of recycled resources)

Index "**I**" is then calculated by one of the following formulas:

$\mathbf{I = I_G + I_W + I_L}$ (1), **or** $\mathbf{I = (I_G + I_W) + I_L}$ (2), or $\mathbf{I = I_G \times I_W \times I_L}$ (3)

A problem remaining to be solved is that, of these three indexes, the best choice depends on the situation. Formulas (1), (2) and (3) are just proposals resulting from committee discussions.

Thus, through the committee's activities, the meaning of environment harmonization has been clarified and a clear definition of low-environmental-impact concrete, which conventional concrete engineering did not define, has been developed. Further, it is

clear that the next step of the committee's work should be to consider the following issues in more detail.

1) What role can JSCE play in promoting low-environmental-impact concrete and how should it approach the task? One possible answer to this is to incorporate low-environmental-impact concrete into the JSCE Standard Specifications for Concrete.

2) What are the future prospects for the cement industry? Like the steel industry, cement is a key part of the national economy and sustainable concrete production is deeply related to sustainable social development. Full discussion of the role of low-environmental-impact concrete is necessary.

3) How can concrete suppliers promote low-environmental-impact concrete? Like all new ideas and new technologies in concrete engineering, its success will depend on the expertise of engineers at ready-mixed concrete producers.

Members

Chairman	Hidenori Hamada (Kyushu University)
Vice Chairman	Shinichi Miyazato (Kanazawa Institute of Technology)
WG Leader	Kenji Kawai (Hiroshima University)
	Toshiki Ayano (Okayama University)
	Makoto Hisada (Tohoku University)
Committee Secretary	Yasutaka Sagawa (Kyushyu University)
Committee Member	Tetsuya Ishida (Tokyo University)
	Makihiko Ichikawa (Taiheiyo Cement)
	Masaki Oshima (BASF Pozzolith)
	Ema Kato (Port and Airport Research Institute)
	Minoru Kunieda (Nagoya University)
	Tsuyoshi Saito (Niigata University; formerly Tokyo Institute of Technology)
	Hiroshi Sakanakura (National Institute for Environmental Studies)
	Mitsuhiro Shigeishi (Kumamoto University)
	Takafumi Sugiyama (Hokkaido University)
	Yasunori Suzuki (Sumitomo Osaka Cement)

Shigehisa Taguchi (Fukuoka prefecture Ready Mixed Concrete Plant Group)

Yasuhiro Dan (Nippon Steel Blast Furnace Slag Cement)

Tsuyoshi Torichigai (Kajima Corporation)

Masahiro Nakai (P. S. Mitsubishi Construction)

Takashi Habuchi (TOA Corporation)

Hideyuki Horii (JX Nippon Oil Energy)

Hisahiro Matsunaga (JFE Steel Corporation)

Takashi Yamamoto (Kyoto University)

Takeshi Yamamoto (Central Research Institute of Electric Power Industry)

Toshinobu Yamaguchi (Kagoshima University)

Hiroshi Watanabe (Public Works Research Institute)