

# **SERIES TOPICS OF Fly Ash Concrete**

## **1st Topic: Advantage of Use of Fly Ash (introduction)**

Coal-fired thermal plants play an important role in the stable supply of electric energy in Japan, and the entire coal is imported from overseas markets. Consequently, a huge amount of coal ash is produced annually as industrial by-product. Its quantity exceeds 10 million tons yearly and this amount is steadily increasing.

In 1991, the so called “recycling law” was enacted in view of the global environment and to foster recycling of resources. Starting from 2001, Japan enacted laws to promote the effective use of resources for social sustainability. Here, fly ash is treated as a “specified by-product”; further use of which is much encouraged through research and development.

Because of the sufficiently high production of fly ash, in addition to its use as a cement additive, in roadbeds, as admixtures to concrete, and in soil foundation, approximately 70% of fly ash is now used in cement clinker production. If the amount of fly ash can be reduced as a constituent material of cement clinker, other industrial by-products can be effectively re-used to further reduce CO<sub>2</sub> emission. In view of the global environmental impact, more effective re-use of fly ash is required. Especially, usage of fly ash as an additive to concrete mixture is regarded as one of the most effective means, but we are behind the international benchmark. This may be attributed to widely varying quality of domestic fly ash due to many types of coal imported from abroad, insufficient supply system, cost structures of the construction industry, and the lack of design procedures to satisfy the current requirements.

In 2007, JSCE concrete board committee established a sub-committee on design and practice for fly ash concrete to further promote the effective use of fly ash in accordance with the performance-based design. To meet the challenge of current social needs, special attentions are directed to the following merits of strategy:

- (1) Upgraded structural durability to meet the needs to realize high quality asset as social stocks.
- (2) Control of ASR and thermal cracking.
- (3) Enhanced workability in practice.
- (4) Reduction of CO<sub>2</sub> emission and as replacement for fine aggregates.

The sub-committee, which is financially supported by electric companies and suppliers of fly ash, has completed the engineering manual, which will be published in 2009. This is to quantitatively assess the quality of fly ash concrete in terms of durability, mechanistic performances, and environmental impacts. The scheme of design is based on performance. This manual also includes a

standard guide to realize fly ash concrete under the required quality and construction in practice based upon up-to-date knowledge and technology.

The research, technical discussion, and codification were performed by six working groups. The sub-committee will then report the activity of each working group at regular intervals in a newsletter in 2009. The six working groups are:

- (1) WG on sustainable society with circulation of resources: The inventory analysis and CO<sub>2</sub> emission, recycling system design with effective resource transportation with regard to CO<sub>2</sub> in the Japanese industry, proposal on new application of fly ash.
- (2) WG on mix design: Quality assurance method, performance assessment, and a new type mix design method to use fly ash as replacement for both fine aggregates and cement.
- (3) WG on strength development: Curing and modeling of strength development in time. Improvement methods of early-age strength
- (4) WG on durability assessment: Design formula on rate of carbonation, chloride ion penetration of fly ash concrete, rate of corrosion of steel in fly ash concrete
- (5) WG on assessment of alkaline aggregate reaction: Replacement ratio of fly ash, quality, effect of aggregates and calcium in mixture, cathodic protection
- (6) WG on crack risk assessment: Thermal and shrinkage cracking, long-term self-healing effect

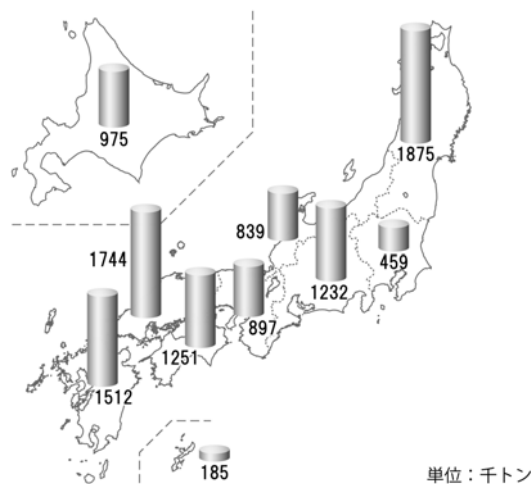


Figure 1 Annual production of fly ash in Japan

◆世界各国の石炭生産・消費量 (単位:百万トン、2004年度世界の石炭生産量総計 4,629百万トン・消費量4646百万トン)  
 および日本の石炭輸入量 (単位:百万トン、2004年度石炭総輸入量 184百万トン)

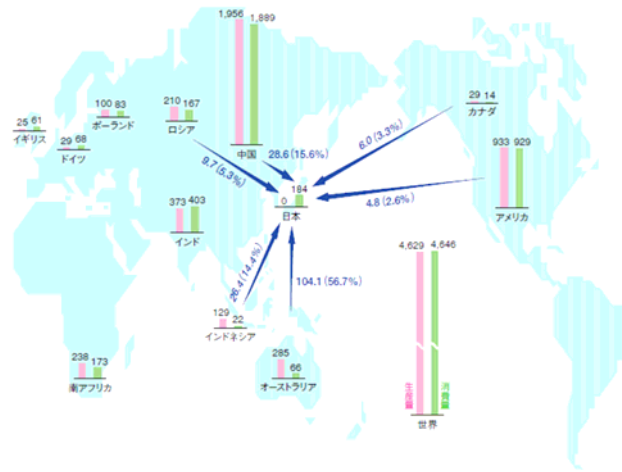


Figure 2 The annual coal production, consumption and the import (2005: unit: million tons)