Newsletter

Japan Society of Civil Engineers
Concrete Committee

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SUBCOMMITTEE 361

RESEARCH SUBCOMMITTEE FOR THE IMPLEMENTATION OF GEOPOLYMER TECHNOLOGY IN THE CIVIL ENGINEERING FIELD

Features of GPs and AAMs

- AAMs, including geopolymers (GPs), are solidified by the condensation polymerization reaction of a powder (active filler) containing a large amount of Si, Al, and Ca components and an alkaline silica solution such as water glass.

- In addition to having the same basic performance as conventional cement solidification, cement-free AAMs are superior in terms of low carbon emissions (some estimate that CO2 emissions from cement production are about 8% of total emissions), immobilization of radioactive waste and other hazardous substances, acid resistance, high temperature resistance, and alkali aggregate reactivity.

Application of GP technology to the construction field

- In the "Research Subcommittee on the Application of Geopolymer Technology to the Construction Field (FY 2015, 2016)" of the Japan Concrete Institute (JCI), (1) the scope and reaction mechanism of GP to be considered, (2) basic material properties of GP such as mechanical properties and durability, (3) examples of GP implementation, and other aspects the latest information from Japan and overseas were collected.

- It is shown that there are issues to be solved in order to implement GP in Japan, such as (1) reviewing the basic properties of GP when using materials available in Japan, (2) the scope of application of conventional material design methods and structural design methods and how to deal with inapplicable cases, and (3) establishing related codes and standards.

Responsibility for this report

Vice-Chairman of subcommittee 361
Dr. Takeshi Yamamoto
[Central Research Institute of Electric Power Industry]

Objective of Subcommittee 361 activities

- Based on the results of these previous studies, this subcommittee (hereinafter referred to as "Sub-committee 361") was established in August 2019,

(1) To investigate and study the basic properties of GP using materials available in Japan
(2) To investigate and study the evaluation method of hardened GP properties
(3) To investigate and study the application of performance-based design methods to GP
(4) To compile information from other countries to establish regulations on GP that meet the actual conditions in Japan.

Examples of Construction

<Acid resistance>
Pedestrian lane separation block

<Acid resistance> Railway sleepers

<Acid resistance> Base concrete

<Acid resistance> Slanted manhole

<Heat resistance> Repair of reinforced concrete retaining wall

Results in WG-1:

Surveys on Basic Physical Properties and Property Characterizations

- The research focused on the latest research since the activities of the GP Research Committee of JCI. In addition, common experiments were conducted on mortars and concretes with unified materials and formulations. The purpose of the common experiments was to confirm the existing information on the basic properties of GP with fly ash and blast furnace slag powder (FA-GGBS), and to contribute to the implementation of GP by providing an example of a recipe.

- The results of WG1 are mainly presented in "Part I: Solidification Reaction Mechanism and Binders", "Part II: Basic Knowledge for Application to Civil Engineering (Properties of Composite Materials)", and "Part III: Common Experiments".

Results in WG-2: Study on structural design

- Using the JSCE Concrete Library 152 (Draft Guidelines for Design and Construction of Concrete Structures Using Large Amounts of Admixtures) as a guide, the applicability of conventional design methods to GP were investigated, and issues were identified when applying performance-based design to structures and members using GP.

- The scope of applicability of conventional designing methodologies to GP and the items that have not yet been developed are clarified by describing cementitious structures and GP in comparison.

- The results of WG-2 are presented in "Part IV: Current status and issues for each intended use".

Results in WG-3:

Survey of Regulations and Applicability to Radioactive Waste Treatment

- It was found that each country is rapidly developing their own standards, and that the PAS (Publicly Available Specification) of the BS standard (British National Standard) can serve as a reference for the establishment of standards in our country.

- Although the GP is expected to be useful for radioactive waste treatment, it is necessary to guarantee the ability to maintain a high level of radioactive immobilization capacity for a long period of time, and the establishment of technology that can guarantee safety and durability at the structural level should be prioritized first. Therefore, we did not deepen the discussion specifically on radioactive waste treatment.