Study on the Properties of Co-fired Wood Pellet Fly Ash as Concrete Admixture

Chemistry and Environmental Research Lab: Lin, Hung-Tao; Chiu, Zhi-Yong

1. Research Background and Methods

In response to the government's energy transition and net-zero carbon emission policies, Taipower has initiated plans to enhance the efficiency of coal-fired units and integrate alternative energy sources. One strategy involves co-firing wood pellets in coal-fired boilers, which can significantly reduce CO_2 emissions from these power plants. However, the disposal and reuse of the co-fired fly ash produced will impact the operation of these plants and the stability of the power supply.

On May 7, 2021, Taipower completed the revision of the national standard CNS 3036, which classifies fly ash from coal and wood pellet co-firing as general fly ash, with the wood pellet content limited to no more than 5% by weight, as stipulated in the Ministry of Economic Affairs' regulations on industrial waste reuse. In response, Taipower launched the "Co-firing Wood Pellet Test Plan" in February 2022. Through meticulous planning, Taiwan's first large-scale co-firing test was conducted at a coal-fired power plant from December 13 to 15, 2022. During this process, operational parameters, flue gas, fly ash samples, and analytical data were successfully collected, providing valuable insights for subsequent evaluations of equipment applicability and the feasibility of fly ash disposal.

According to the revised national standard CNS 3036 and the regulations established by the Ministry of Economic Affairs, coal-fired boilers are permitted to co-fire up to 10% (by weight) wood pellets alongside coal. The resulting co-fired fly ash can be utilized in concrete as a supplementary cementitious material. To ensure the quality of domestic concrete projects, Taipower has adopted a cautious approach by commissioning a third party to verify the differences in properties between coal fly ash and co-fired fly ash before incorporating wood pellets into the power generation process. This initiative was undertaken to address concerns from the ready-mix concrete industry regarding the use of co-fired fly ash and to promote the applicability of this material. The study was planned as follows (Figs. 1-2) :

(1) Literature review.
(2) Co-fired fly ash material properties testing.
(3) Co-fired fly ash concrete properties testing.
(4) Co-fired fly ash concrete production test at ready-mix concrete plants.
(5) Interviews with ready-mix concrete plants.

2. Research Results

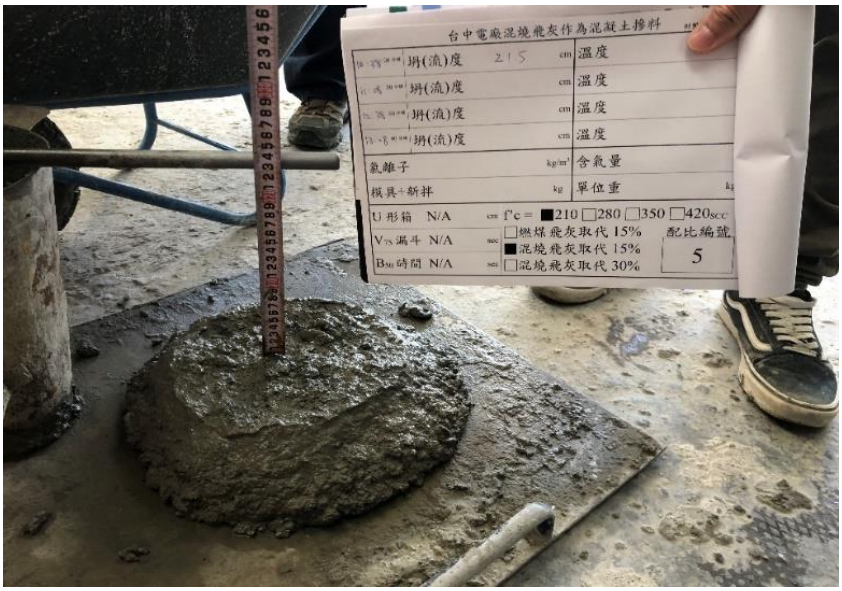
(1) Co-fired fly ash material properties testing: Both coal fly ash and co-fired fly ash (3.4% w.t.) meet the requirements of CNS 3036 Class F. Furthermore, there are no significant differences in the test results for fineness, specific gravity, and other parameters between the two types of fly ash.

(2) Co-fired fly ash concrete properties testing: There is no significant difference in the properties of fresh and hardened concrete when comparing coal fly ash concrete to co-fired fly ash concrete.

(3) Co-fired fly ash concrete production test at ready-mix concrete plants: There is no significant difference in the production process, energy consumption of production equipment, properties of fresh concrete, and strength between coal fly ash

concrete and co-fired fly ash concrete.

(4) Taipower can gradually increase the co-firing ratio of wood pellets from 3.4% in a progressive manner to meet the government's carbon reduction targets while minimizing resistance from the concrete industry.



Source: This study

Figure 1 Co-fired fly ash concrete properties testing

Source: This study

Figure 2 Interviews with ready-mix concrete plants