Development of optimized incineration process of fisheries waste for synthesizing a functional heat storage material

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A part of fishery waste, such as scallops or oyster shells, are utilized for fertilizer, feed, soil conditioner, or fishing ground preparations, and most of the shells from aquaculture residue are incinerated as general waste at or above 1273 K using a huge amount of fuels and cost. And the most of the incineration products are used for a landfill disposal. For the establishing the sustainable fisheries industry and local community, the reduction of the incineration cost and utilization of the incineration products are indispensable. In this research, the incineration temperature of fisheries waste was examined for lowering incineration temperature. Addition to the investigation on the incineration temperature of fisheries waste, the properties of the calcium oxide derived from the fisheries waste as heat storage material was also evaluated based on the thermal analysis.

The samples used for thermal decomposition kinetics investigation are 2 species of shells (Scallop *Mizuhopecten yessoensis*, Oyster *Crassostrea gigas*), a spines of a sea urchin *Mesocentrotus nudus*, and calcite reagent (purity 99.95%). The surface deposits on these shells and spines are removed using a wire brush or tweezers, then washed by tap water. The cleaned samples were crushed in a porcelain mortar, then dried in an oven at 383 K. The dried powder particles were allied by their size using a sieve to sort in size in the range between 63 and 125 micron meter. The thermal incineration temperature was investigated using these samples.

Calcite reagent (purity 99.95%) the sorted, shells (Scallop, Oyster, Myoida *Hiatella orietalis*, and Tube worms *Dexiospira foraminosus*), and spines of Sea urchin were thermally decomposed for 1 hour at 1273 K to be converted to calcium oxide and then reacted with distilled water to prepare $Ca(OH)_2$. The thermal decomposition temperature of the $Ca(OH)_2$ of these samples was experimentally investigated for the evaluation of the incineration product as a heat storage material.

The prepared powder samples were put in a platinum container covered with Pt disk and then installed in a Differential Scanning Calorimetry. The samples were heated up with the temperature increasing rate from 5 K /min to 40 K /min in Ar atmosphere (99.9999%).

The thermal decomposition complete temperature is depending on the temperature increasing rate. As increase of the temperature increasing rate, thermal decomposition temperature of each samples became higher. The activation energy and frequency factor of the thermal decomposition were determined from the relation between thermal decomposition complete temperature and the temperature increasing rate. However, there is only 8% difference in the activation energies of thermal decomposition among the all samples. This result implies that the thermal decomposition kinetics is mainly controlled by the frequency factor.

Meanwhile the thermal decomposition temperature of the $Ca(OH)_2$ differs each other depending on the derived specimens. There is a weak positive correlation between the thermal decomposition temperature of calcite and calcium hydroxide. The shells and spines having lower thermal decomposition temperature have lower thermal decomposition temperature of calcium hydroxide. The incineration products from shells and spines have also better reaction property than that of derived from the calcite reagent.

These differences could be caused by the microstructures of the reagent, shells and spines. The adjustment of the particle size of shells during the firing can further reduce the reaction temperature and fuels and control the reaction property as a heat storage material.

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