Transactions of the Materials Research Society of Japan 26 [3] 853-854 (2001)

WOODCERAMICS SERIES PREPARATION DEVICE (DESIGN & PRODUCTION)

TAKESHI KUTSUZAWA & YOSHIO NODA

KUTSUZA Technology & Research Institute

8-2-1-35 Kikusui Shiroishi Sapporo Japan

Fax : +81-11-816-1602

The fundamental researches of "Woodceramics" have been carried out in detail by Toshihiro Okabe (Industrial Research Institute of Aomori Prefecture) and the other staffs for years. The production process is, however, limited to batch system apparatus, development of continuous (series) apparatus is urgently expected to provide for the mass production. Under this background, we have decided to design a series preparation test apparatus, which could accomplish manufacturing "Woodceramics" continuously. In order to develop a testing device, we compile a various number of the analysis data from the materials, such as the heat gravity or element, and finally succeeded to design the series carbonization-testing device.

1. Introduction

MDF plates (medium-density fiber plates) are impregnated with liquid phenol resin and dried, baked under the temperature of around 800℃ and woodceramics are able to obtain during this process. This is carbonaceous new materials and has quality acceptable ecologically. In addition, it has pore structure, excellent properties such as lightweight, hardness, acid resistance and thermal resistance. Moreover it can be produced from wood, sawdust, or used lumber and is considered to be a new environmental friendly material. This woodceramics has been expected to be used widely in the industrial market in the future, and currently a number of private companies or academic institutes have carried out the application research. However as mentioned above, production process was the key to expand these excellent materials to the market.

In order to meet this demand, our laboratory started to study the continuous (series) production system under corporation with Toshihiro Okabe (Division director of Industrial Research Institute of Aomori Prefecture) and Kakuhiro Co. Ltd. and succeeded to develop the continuous (series) carbonization / activation test plant. This report described the process of development for the continuous apparatus based on the thermal or elementary analysis data, which was obtained through fundamental investigation.

2. Experimental method

It was confirmed from the experimental results of hardness, acid / heat-resisting properties, electro-magnetic shielding characteristics and other properties of woodceramics that the heat temperature affected largely on the quality of woodceramics itself. Accordingly, to determine the treatment conditions of the thermal decomposition, that is the critical point of continuous production, thermal gravity analysis was performed.

The thermal gravity analysis was performed in the atmosphere of inert and active gas, and the thermal decomposition conditions were determined. For the analysis preparation, Ozawa method was used. Two kinds of oxidation decomposition temperatures, 314.4℃ and 453.7℃, were recognized.

It was considered that oxidative decomposition of lignin cellucaze occurred at 314.4℃ and that the oxidative decomposition of phenol compounds occurred at 453.7℃. Considering these results, the characteristics and yields of the carbonized products (woodceramics), it is estimated that the too rapid thermal treatment would disturb the formation of the precise wood-ceramics structure.

This leads that the best treating method for the production of woodceramics with the precise structure is two-stage carbonization process (at the first stage the resin is fixed by the carbonization under the mild condition). At first stage the thermal treatment temperature was determined to be 315℃, and the second stage about 500℃.

After the consulting with research data and analytical results and conditions, the horizontal rotary furnace (rotary kiln) was selected to be the best. For the design, corrosion and heat resisting material was selected to prevent the reaction between wood tar and the material of apparatus, which brought the contamination of the product with impurities.

N_2 gas : 100ml / min : 187.503kj / mol
(400℃ about 50%, 500℃ around 43%)
Air : 100ml / min about 192.062kj / mol

3 Experimental results

Considering the characteristics of test sample and the quality of transportation, continuous (series) carbonization apparatus was developed through the process shown in the flowchart.

Sample was fed with feeder from the feeding hopper into the rotary furnace at a constant rate, carbonized continuously, and stocked in the recovery box. The decomposed tar components and the decomposed products, which were produced at the carbonization, were condensed and captured in the cooling and condensing furnace and recycled. The emitted gas, which is not captured, was burned in the deodorant furnace, and emitted into air through emitting furnace. This apparatus was to used for activation, and the selection of the burner, which could cover the wide temperature range from the temperature of 900℃ in the furnace to 315℃ of carbonization process, would be important in the future and now under the investigation. The emitted gas from heating furnace is very clean, and it has the quality to be utilized. Accordingly, it is also considered how to use.

4. Summary

In order to design and construct the carbonization production apparatus up to the industrial scale, the decision of the suitable size of reaction apparatus, the selection of the apparatus materials, and the suitable operating conditions would have to be resolved.

Measurement: TG-DTA2010S **Material:** Wood
Comment: Air-200/ Pt2.5t **Date:** Sep8,2000 17:09
Sampling: 5.0sec **Material weight:** 2.38mg
Rise temp speed: 5.0deg/min

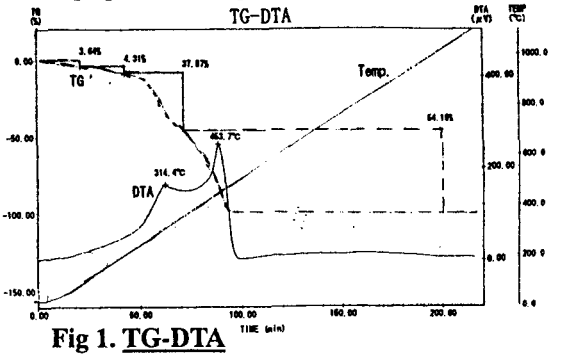


Fig 1. TG-DTA

① Hopper for materials ②Feeder
③ Nitrogen processing device ④Heater
⑤ Horizontal Kiln ⑥Rotary blower for air
⑦ Deodorizer ⑧Exhaust ⑨⑩Cooling tower
⑪ LPG or Propane gas

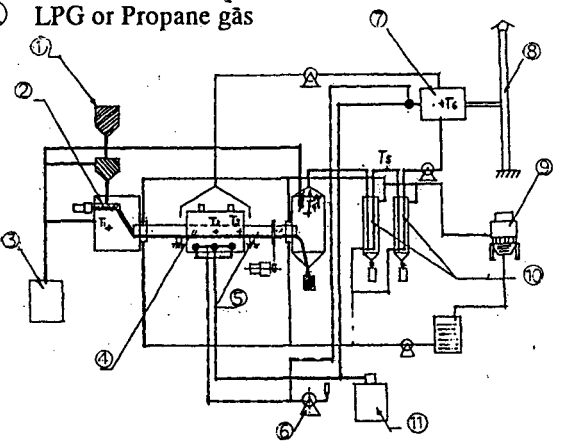
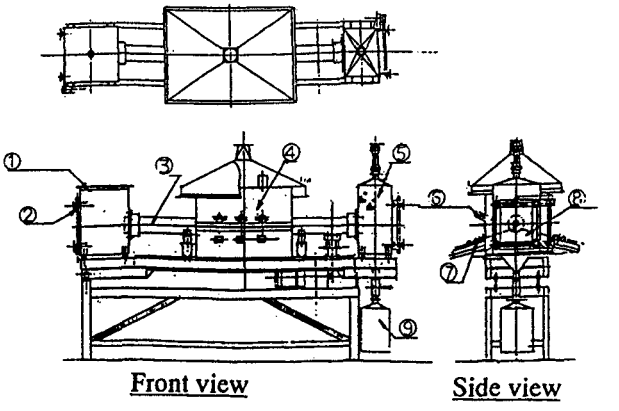


Fig 2. Flow Chart of Series Carbonization Apparatus

①Material provide box ②Door ③Kiln body
④Heat fireplace ⑤Material collecting box
⑥Window ⑦Burner ⑧Door
⑨Product collecting box



Front view Side view

Fig 3. Horizontal Rotary Kiln