IN THE LABORATORY

High-Frequency Dielectric Heating in Heterogeneous Catalysis

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High-frequency dielectric heating of materials is rapidly becoming a common practice in the plastics, wood, cellulose, and other industries (*1*). There are many advantages in this method of heating materials to a desired temperature. Since the dielectric heating arises within the material, due to rotational motion of molecules or translational oscillation of ions, the material is heated uniformly from the inside, and the factors of heat transfer are not involved. High-frequency dielectric heating is characterized by (1) speed of attaining a desired temperature, (2) uniformity of heating, and (3) absence of heat transfer from without.

These features make it very attractive for application in heterogeneous catalytic reactions. The uniformity of heating

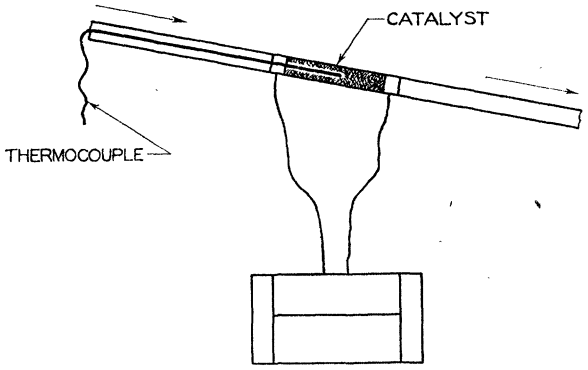

FIG. 1.

will eliminate the local overheating in spots of the catalyst and consequently minimize undesirable side reactions, increase the life of the catalyst, and produce a more uniform product. The rapidity of attaining the desired temperatures might decrease the over-all processing time, increase the space velocity, and decrease the size of the catalytic chamber.

These last features could have particular advantage for catalytic processes using a so-called "fluidizing" technique such as fluid catalytic cracking of petroleum. Naturally, only such solid catalysts as are dielectric by nature can be heated by high-frequency electric field.

In the following experiments, conducted in our laboratory, two reactions were carried out using dielectric catalysts: (1) dehydration of ethyl alcohol over alumina, and (2) dehydrocyclization of heptane to toluene over chromia-alumina.

The apparatus[1] consisted of a pyrex glass tube, with an inside diameter of 20 mm., filled with catalyst. The catalyst bed was 20 cm. long. Two brass electrodes were placed on both ends of the catalytic bed, outside the glass tube and connected to a Westinghouse radio frequency generator (1-KW unit).

After establishing a desired temperature (measured by a thermocouple placed in the center of the catalyst bed), which took from 3 to 5 minutes, the materials were introduced and the products recovered and analyzed in the usual way. The arrangement is shown in Fig. 1. The reactions proceeded with excellent results, giving a 90 per cent yield in the case of dehydration (at 350° and space velocity of 0.5) and 75 per cent yield for dehydrocyclization (at 500° and space velocity of 0.5).

Reference

1. DAKIN, T. W., and AUXIER, R. W. *J. ind. eng. Chem.*, 1945, **37**, 268; SCHUTZ, P. W., and MCMAHON, E. K. *Ibid.*, 1946, **38**, 179.

Method for Differential Staining of Mycorrhizal Roots

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In connection with an investigation of the cause of a foliar decline disease of southern pines (*2*), a study was made of the anatomical features of mycorrhizal roots formed on shortleaf pine (*Pinus echinata* Mill.). Several techniques have been used for the differential staining of hyphae of the Hymenomycetes, which form the mantle and Hartig net of ectotrophic mycorrhizae. Cotton blue in lactophenol is fairly specific for the hyphae provided counterstaining is not desired. Young (*6*) also obtained satisfactory results with cotton blue. McArdle (*3*) used the following differential methods: (1) hematoxylin with safranine, and (2) Pianeze III. In a study of the mycorrhizae of Colorado flora, Thomas (*5*) used a combination of safranine and fast green. A modification of the orseillein BB procedure described by Strasburger (*4*) has been used for staining mycorrhizae. (It should be mentioned that orseillein is not the same as orcein.) The procedure is as follows: Stain for 10 hours in a saturated solution of orseillein BB in 3 per cent acetic acid and counterstain with crystal violet in clove oil. All of the above techniques failed to contrast clearly the mantle and Hartig net with the cortical elements of the short roots.

Experimental tests demonstrated that a modification of Cartwright's (*1*) picroaniline blue procedure is superior to the above techniques for the differential staining of mycorrhizal roots. In the procedure which has been adopted for

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