Composition and Fertilizer Value of Spent Phosphate Catalysts from the Petroleum Industry: "Solid Phosphoric Acid Catalysts" and Copper Pyrophosphate Catalysts


In recent years phosphates have assumed considerable prominence as catalysts in the refining of cracked gasoline. Casual study of a descriptive classification of catalysts proposed for use in petroleum refining (3) reveals a rather long list of phosphorus compounds that includes oxides of phosphorus, both P2O5 and P2O3, phosphorus acid, ortho-, pyro-, and metaphosphates of the alkali and alkaline earth metals, and some phosphides. Although very little data relating to the quantities of phosphorus consumed in catalysts are available (1), it is known that by far the larger part of the phosphorus used in petroleum catalysts goes into "solid phosphoric acid catalyst" (7 to 14). A considerable tonnage of spent catalyst occurs as a refinery waste product that is a potential source of phosphorus for fertilizer use. Spent catalyst of another type, copper pyrophosphate catalyst (15, 16, 17, 18, 20), attracts interest as a possible source of copper for plants growing on copper-deficient soil. Selected samples of the two types of catalysts were analyzed and four of them were tested in plant growth experiments. The results of the study are presented in this paper. As far as the authors are aware, the only published work on the fertilizer value of these materials is an article by Fraps (3) who made tests on spent "solid phosphoric acid catalyst".

MATERIALS AND ANALYTICAL METHODS

The materials consist of seven samples of "solid phosphoric acid catalyst" and four samples of copper pyrophosphate catalyst. Phosphoric acid catalysts No. 2386 to 2388 and copper pyrophosphate catalysts No. 2414, 2416, and 2417 were received in 1945, whereas the other samples, Nos. 2382 to 2385, were collected in 1941. Other pertinent descriptive data are presented with the chemical analyses in Table 1.

The materials (20-mesh) were analyzed with the use of standard procedures.

1Contribution from Division of Soils, Fertilizers, and Irrigation, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Dept. of Agriculture, Beltsville, Md. Received for publication November 11, 1946.

2Assistant Agronomist, Senior Chemist, Junior Chemist, Associate Chemist, and Senior Chemist, respectively. The authors are indebted to J. C. Day, Secretary, Western Petroleum Refiners Association, to the producer of "Solid Phosphoric Acid Catalyst" and to a number of refineries for the catalyst samples, to E. F. Miles and Katharine S. Love, of this Bureau, for the carbon and nitrogen determinations, respectively, to J. O. Hardesty and S. B. Hendricks, of this Bureau, for the hygroscopicity measurements and X-ray diffraction examinations, respectively, to K. D. Jacob, who suggested the study, and M. S. Anderson, both of this Bureau, for valuable council, and to R. V. Allison, Florida Agricultural Experiment Station, Belle Glade, Fla., for the copper-deficient soil.

3Numbers in parenthesis refer to "Literature Cited", p. 325.