NOTE

Boron Arsenate

BY GUSTAV E. R. SCHULZE

Schumb and Hartford in a recent article dealing with boron arsenate,[1] while referring to my publications[2] in this connection, report new values for the density and refractive index of boron arsenate which deviate greatly from those which I reported in the above-mentioned articles, without attempting any explanation of these differences.

Schumb and Hartford found for the density of $BAsO_4$ at room temperature 3.40 and for the refractive index, with the sodium D line, 1.66; I obtained densities by three entirely independent methods of 3.64–3.66, and indices of refraction $\omega = 1.681$ and $\epsilon = 1.690$. While my preparation consisted of single crystals with edges about 0.1 mm. long, that of Schumb and Hartford (according to a private communication) was extremely finely divided, so that the refractive index could only be determined under a microscope for a conglomerate of single particles and could therefore only yield a mean index.

Since the purity both of my preparation and that of Schumb and Hartford was confirmed by analysis, it may be that the discrepancies are to be ascribed to the very different degree of dispersion. A second possibility is that the low values for the density and the indices of refraction resulted from the increasing difficulty of measurement with decreasing size of particles. A third, but quite unlikely possibility, is that the discrepancies are due to the existence of two modifications of $BAsO_4$.

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RECEIVED JANUARY 30, 1935

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[1] Schumb and Hartford, THIS JOURNAL, **56**, 2646 (1934).

[2] Schulze, *Naturwiss.*, **21**, 562 (1933); *Z. physik. Chem.*, **B24**, 215 (1934).

[CONTRIBUTION FROM RESEARCH LABORATORIES OF THE SHELL DEVELOPMENT COMPANY]

Direct Alkylation of Aromatic Hydrocarbons by Olefins under the Catalytic Influence of Phosphorus Pentoxide

BY B. W. MALISHEV

The direct alkylation of aromatics with olefins was first accomplished by Balsohn[1] in 1879, *i. e.*, two years after Friedel and Crafts published their synthesis with aluminum chloride. Since Balsohn, other investigators have made developments in this field, using the same catalyst. The present investigation was undertaken with the object of finding a catalyst similar to aluminum chloride for this type of alkylation and it has been found that phosphorus pentoxide is very effective.

Inasmuch as phosphorus pentoxide is insoluble in hydrocarbons, its effectiveness as a catalyst is dependent upon producing and maintaining a large contact surface. Commercial phosphorus pentoxide is in a state of colloidal subdivision but its simple colloidal dispersions in hydrocarbons are not stable and readily coagulate to hard infusible or sticky masses. Consequently in the course of this investigation the necessity to maintain phosphorus pentoxide in its colloidal state was recognized and suitable dispersions were developed through the use of stabilizing colloids and peptizing agents. The best stabilizing colloid for the purpose of this investigation was found to be lampblack. F. S. Brown and C. R. Bury[2] obtained colloidal dispersions of phosphorus pentoxide in nitrobenzene by peptization with alcohols, phenols or organic acids. In this investigation cresol was found to be quite effective for peptizing lampblack–phosphorus pentoxide dispersions in hydrocarbons.

In general the alkylation of aromatic hydrocarbons with olefins in contact with stabilized dispersions of phosphorus pentoxide becomes noticeable at 150°, with the optimum temperature at from 200 to 250°. Pressures up to 40 atmospheres were used in the experimental work, a description of which is given herein.

Phosphorus pentoxide has practically no polymerizing effect on the lower olefins by itself. Higher olefins are polymerized to naphthenes but only to a small degree under the conditions favorable for alkylation of aromatics. In fact, it has

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[1] Balsohn, *Bull. soc. chim.*, [2] **31**, 539 (1879).

[2] Brown and Bury, *J. Phys. Chem.*, **29**, 1312 (1925).