THE CARBON BLACK - OXYGEN REACTION: OXIDATION PROMOTORS

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The ignition temperature of carbon blacks will vary between approximately 375° C and 500° C depending upon type and treatment after actual manufacture. However, carbon blacks will react with oxygen at readily controlled rates below these temperatures and the products of this reaction are carbon dioxide, carbon monoxide, and water, and as this reaction progresses the residual sample will become more and more enriched with oxygen and its surface area will steadily increase.

All furnace blacks have inorganic compounds as contaminates at their surface because well water is used to quench the carbon black formation reaction and to cool the smoke stream to reasonable temperatures.

The unusual effect of approximately one percent of unanalyzed inorganic matter on the surface of a furnace black during oxidation is illustrated in Figures 2 and 3, pages 282 and 283, in the "Proceedings of 1957 Conference on Carbon". (Snow, Wallace, Lyon, and Crocker.

In contrast with furnace blacks, channel blacks contain substantially no extraneous matter and one with only 0.02% "ash" was chosen for controlled experiments designed to study the efficacy of various inorganic materials upon the carbon black - oxygen reaction.

The materials studied were the aqueous extract from the furnace black noted above, powdered iron, sodium sulfate, cerous nitrate, cobaltous nitrate, ferric nitrate, ferric oxide, ferric sulfate, nickel formate, lithium sulfate, and manganous sulfate.

The powdered iron and the ferric oxide were simply mechanically blended with the channel black. The other materials were added as aqueous solutions and then dried. Where possible the metallic salt, while on the carbon black surface, was decomposed to the metal in a stream of nitrogen. Obviously the metal was then converted to the oxide sometime after the oxidation reaction began and residue weights in practically all cases agreed with the theoretical values.

All of the materials studied acted as oxidation promotors. Most of them significantly altered the carbon dioxide - carbon monoxide relation, decreased oxygen chemisorption, and decreased surface area expansion.

Cobalt and nickel allowed no carbon monoxide to escape the reaction cell, and only a minute quantity of carbon monoxide was collected when ferric nitrate was the original contaminant. Cobalt and cerium were most effective in inhibiting surface area expansion and hence chemisorption of oxygen.

While the channel black used will oxidize at only a barely measurable rate at 220° C and will allow the initial oxidation phase to begin at 280° C without actual ignition, some of the materials studied were so active as oxidation promotors that the initial oxidation phase temperature had to be reduced to as low as 200° C to avoid ignition.