

## **Discovery of Tin and Phosphorus Effects on the Direct Synthesis of Methylchlorosilanes**

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Concurrent with the commercialization of the copper catalyzed Direct Process Reaction of methyl chloride with silicon, research efforts got underway, not only to explore what new products could be made and sold, but also how to make those products more economically. While the direct process reaction was a significant improvement over the Grignard process, the yields to desirable products were dismal when compared to today's standards. The progress in the field was hampered by a lack of a fundamental understanding of the chemistry of the reaction, and much of the improvements made were simply finding a better source of copper and a better source of silicon with minor tweaks in the process. The search for other catalysts for the reaction led to the discovery of the benefits of adding zinc in addition to copper and helped direct the attention of researchers to looking at the synergistic effects of additives to the reaction.

As with practically all the other additives evaluated, tin and phosphorus have been seen as positive by some researchers and negative by others. This is undoubtedly due to the changing picture as to the quality of the silicon raw material and the copper catalyst. Few of the silicon and copper impurities were suspected to have the kind of impact on the Direct Process Reaction, at the levels they were present, as is observed today.

The effects of tin on the Direct Process Reaction had been observed by researchers at Dow Corning by 1950 as experimentation got underway to try to control the distribution of products. Other researchers as well noted its impact, but consensus of whether it was positive or negative was not achieved for several years.

Like tin, phosphorus has been investigated since the early 1950's. When first added as phosphorus trichloride to the Direct Process Tumbler reactors, little effect was observed. Phosphorus has been reported by other researchers since that time to be both a promoter and a poison to the Direct Process Reaction. The different conclusions concerning the effect of phosphorus on the Direct Process Reaction was likely due to the varying techniques used to add phosphorus to the reaction contact mass, as well as other additives/impurities present in the silicon raw material and copper catalyst.