On the Sensitivity of Tropylium Perchlorate to Heat, Spark, Impact, and Friction

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The occasional reports that tropylium perchlorate is a sensitive explosive\(^1,2\) doubtlessly deter the employment of the quickest and easiest high-yield preparation of tropylium salts\(^3\). After 15 years\(^4,5,6\) we have yet to experience any problems employing tropylium perchlorate on reactions involving anywhere from milligrams to kilograms of this compound. This safety record results from the simple precaution of adding 1 g of water per 100 g of tropylium perchlorate before storage. In those cases where “anhydrous” material was desired, the tropylium perchlorate was washed several times with anhydrous diethyl ether which was removed by decantation followed ultimately be evacuation at \(<1\) torr. Such material is suitable for all reactions requiring anhydrous conditions such as Grignard reactions and the examination of nucleophilic reactions\(^4,7\).

The anhydrous material is an explosive of great sensitivity. Using semi-quantitative test procedures, we found that drop tests with a 2 kilogram weight (1 cm\(^2\) anvil) gave twenty successive failures to detonate only when the distance was less than 2.2 cm (compared with 6.9 cm for nitroglycerin). Similar tests for spark sensitivity gave a value of 1.25 joule, which is comparable to the value for nitrocellulose. Sliding-friction tests yielded a value of 129 newtons at a 60° angle which is close to the value found for a 50% solution of nitroglycerin in triacetin. Tropylium perchlorate is stable to heat and fails to ignite spontaneously below 300°. Ignition in all tests was accompanied with noise, smoke, and flame.

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\(^1\) Sensitivity work performed at Hercules Inc., Magna, Utah.
\(^5\) D. N. Kursanov, M. E. Volpin, Doklady Akad. Nauk SSSR 113, 339 (1957); This preparation can be scaled directly by a factor of 300 with no complications, dichloromethane can be used in place of at least one half of the carbon tetrachloride and reaction times of 3-6 hr furnishes slightly better yields than overnight.
\(^6\) C. E. Wulfman, F. Yarnell, D. S. Wulfman, Chem. & Ind. 1960, 1440.
\(^7\) D. S. Wulfman, J. J. Durham, C. E. Wulfman, Chem. & Ind. 1962, 859.