

Electrostatic safety in propellant manufacturing

Frederick Paquet¹, Mario Paquet¹

¹ General Dynamics – Ordnance and Tactical Systems, Valleyfield / Canada

Abstract:

Propellants are energetic materials designed to quickly convert chemical energy into mechanical and thermal energy. This is accomplished through controlled combustion for various applications such as airbags, rockets, guns, and high-speed safety systems. Because propellants are often in the form of granular material, they have a potential for static electricity generation during manufacturing and handling. The situation is comparable to that of other granular materials and powders. Propellants are however more problematic as they are classified as explosives and thus do not require external oxygen to burn at their full potential. They also are highly sensitive to thermal, impact, friction, and electrical stimuli. To make matters worse, propellant manufacturing uses large quantities of flammable solvents and processes that can generate explosive dust mixtures. Analyzing hazards in a propellant and explosives manufacturing environment is therefore a complex but essential task. Although the physical and material properties of propellants can be compared to that of other, more common, materials, not much information has been published on the subject. This is unfortunately illustrated by many reports of dramatic incidents with casualties where electrostatic safety was involved.

To mitigate this lack of applied knowledge, various testing was performed on the electrical properties of propellants. Basic electrical properties such as resistivity, permittivity and capacitance were obtained. Triboelectric and induction charge generation potential was evaluated using small scale tests. Using the previous data, it was possible to model and test the charge relaxation potential of various propellant configurations. Finally, the ignition sensitivities of propellants to electrical discharges were measured using a standard test. All measurements were made with propellant material of various forms found during manufacturing steps. From this, it is possible to define various propellant families and place them in triboelectric series. Using the data gathered, manufacturing process conditions can be tailored to keep charge generation and discharge probabilities to acceptable levels while maximizing efficiency. Process speeds, equipment and container dimensions, proper grounding, atmospheric conditions and various procedures now reflect these findings. There is nevertheless still research work needed to model specific aspects of electrostatic hazards in energetic materials environments.

Keywords:	Energetic materials, propellants, electrostatic safety, sensitivity
Category (topic):	Hazards
Preference:	Oral
Corresponding author:	Frederick Paquet
E-mail:	frederick.paquet@gd-ots.com