2357 Ventura Drive Suite 108, Woodbury, MN 55125
www.dyneusa.com, Telephone: 651-917-0644, Toll Free: 800-632-2304, E-Mail: lab@dyneusa.com

Dry Chemical Composition

By Grant Lobdell

According to the current, 2018 edition of the National Fire Protection Association 10 *Standard for Portable Fire Extinguishers, "*Only those agents specified on the nameplate or agents proven to have equal chemical composition, physical characteristics, and fire-extinguishing capabilities should be used." (7.8.3.1) Furthermore, dry chemical agent can only be re-used if it has been "thoroughly checked for the proper type, contamination, and condition." (7.8.3.3.1, 7.8.3.4.2). An understanding of and the reason behind the chemical composition of the various types of dry chemical agents leads to a better understanding of these requirements.

A dry chemical agent is defined by NFPA 10 as "A powder composed of very small particles, usually sodium bicarbonate-, potassium bicarbonate, or ammonium phosphate-based with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities." (3.3.4.1) In this definition, there are three chemicals called out as the basis of dry chemical agents: sodium bicarbonate (baking soda), potassium bicarbonate, and ammonium phosphate. These ingredients are the main ingredients in BC, purple K, and ABC dry chemical agents, respectively. Typically, these main ingredients make up the majority of a dry chemical agent and are in concentrations ranging anywhere from 60% to as much as 90%, varying from product to product based on the manufacturer's preference for achieving their desired rating for their desired application. The remaining composition of a dry chemical agent will be made up of secondary ingredients if necessary (ammonium sulfate, calcium carbonate, etc.) and Fuller's Earth, Mica, or another type of mineral specially treated as refenced in NFPA's definition. For those agents that have a distinct color, the formulation will then also contain a very small amount of dye.

Different chemical compositions are used for different applications. A chemical that works great on flammable liquid and electrical fires may not perform as well on ordinary combustibles as another chemical. For this reason, the proper type of agent for the application must always be installed in an extinguisher. Furthermore, mixing of dry chemical types can be dangerous. For example, the mixing of an ABC agent and a BC agent, even in small amounts, can create a chemical reaction that leads to the production of carbon dioxide and water. The carbon dioxide will further pressurize the extinguisher shell, possibly leading to an explosion, whereas the water will create caking of the agent and prevent it from flowing as designed. Both situations can be disastrous which is why NFPA 10 requires the verification of proper type before dry chemical agent re-use.

Not all dry chemicals of the same type are equal though. Two agents with the same main ingredient can contain that ingredient in vastly different concentrations for various reasons which can lead to performance differences. When an extinguisher is listed, meaning it has been evaluated by a third party, independent laboratory testing against a set standard to verify performance, it is only ever evaluated with a specific chemical composition. Little is known about the extinguisher's performance using any other agent, even those of the same type, and, therefore, is not allowed. Even when the concentration of sodium bicarbonate, potassium bicarbonate, and/or monoammonium phosphate match that of the listed agent, the other ingredients that may be present and/or the particle size of the agent may be incompatible with the equipment and/or application to maintain the extinguisher's rating and its listing. For this reason, NFPA 10 requires that only the agent(s) specified on the nameplate be used in each extinguisher. To prove any other agent is of equal chemical composition, physical characteristics, and fire-extinguishing capabilities requires extensive testing. This cannot be determined by a visual inspection.

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