Dry Chemical Testing Explanation

**Moisture Content**

Dyne evaluates the moisture content (%) of dry chemical samples by using Karl Fisher coulometry. The moisture in the sample is driven off the sample by exposing it to high temperatures and dry air. The moisture is collected in the dry air flow which is transferred to a collection vessel where it is quantified by monitoring the resulting electrolysis reaction.

The 2018 edition of ISO 7202 *Fire protection – Fire extinguishing media – powder*, section 10, states that the moisture content of a dry chemical agent should be <0.25%.

A sample with high moisture content is subject to caking which can impact the agent’s ability to flow through equipment as designed.

**Chemical Composition**

Dyne evaluates the chemical composition of dry chemical samples by using ion chromatography. The sample is dissolved in a solvent which is injected into a specific column designed to separate the resulting ions in solution. The ions coming off the column are quantified using conductivity. The following ions are currently identified and quantified (%) as part of this process: ammonium, calcium, carbonate, phosphate, potassium, sodium, and sulfate. The detection limit of each component is 1%.

There are no requirements set on the concentration of individual ions.

**Interpretations**

The ions identified and quantified as part of the chemical composition test are interpreted to determine the amount (%) of each of the following compounds:

- Monoammonium Phosphate (MAP)
- Sodium Bicarbonate
- Potassium Bicarbonate
- Ammonium Sulfate
- Calcium Carbonate

The interpretation is done as follows:
1) For each compound, Dyne determines which ion in the compound is the limiting ingredient based on the composition results.
2) For each compound, Dyne then determines, at most, how much of each compound there can theoretically be in the sample based on the amount of limiting ion.
3) For each compound, Dyne then evaluates if the ions used to calculate each compound concentration are found in another compound Dyne is also reporting for the sample. If there is overlap of ion usage, Dyne evaluates if there is enough of each ion for all of the compound concentrations reported. If there isn’t enough of an ion(s) present for the concentrations reported, Dyne gives precedence to the compounds in order of concentration possible (high to low).

The concentration of each compound is compared to what is declared on the safety data sheet (SDS) for the specified product. According to the 2018 edition of ISO 7202 Fire protection – Fire extinguishing media – powder, section 5.4, a dry chemical agent must be within ±1% (for components designed to be between 10-15%), ±1.5% (for components designed to be between 15-25%), ±2% (for components designed to be between 25-65%), or ±3% (for components designed to be above 65%) of the manufacturer declared concentration.

A sample deemed to fail one or more of the chemical composition requirements can be a concern for a variety of reasons:

- A sample that is found to have low concentration of one of the compounds reported may have low fire extinguishment performance.
- A sample found to have higher than advertised concentration of any of the compounds reported can indicate the sample is not the agent indicated. The 2018 edition of NFPA 10 requires “only those agents specified on the nameplate or agents proven to have equal chemical composition, physical characteristics, and fire-extinguishing capabilities shall be used” (7.8.3.1).
- A mixture of agents can cause dangerous reactions to occur. Specifically, mixing of ABC and BC agents can cause ingredients in the two to react and produce carbon dioxide and water as byproducts. The carbon dioxide can over pressurize containment vessels. The 2009 edition of EN 615 Fire protection – Fire extinguishing media -Specifications for powders (other than class D powders) states the following in Section 7 Chemical Content: “Such increases in pressure have been known to cause containers to rupture, and to cause bodily injury and damage.” Furthermore, the water produced by the reaction of ABC and BC agents can cause caking thus impacting the agent’s ability to flow through equipment as designed.

**Special Considerations**

The filler used in dry chemical agents, typically Fuller’s earth, mica, and/or clay, can contain sodium, potassium, and/or calcium which may appear in the chemical composition results and explain if these ions are found in excess.

If Dyne receives a sample where the manufacturer, type and product are NOT specified on the sample return form, Dyne ONLY verifies if the sample contains components associated with just one type of agent (i.e. it is not a mixture of agent types). Dyne does NOT evaluate if the amount of each component is sufficient for the application or if the agent is listed with any equipment referenced.

Dyne only states a sample may be the agent specified when test results fall within the requirements due to overlapping chemical compositions between some agents. At this time, Dyne cannot differentiate the manufacturer of agents that have equal chemical composition.

The contractor and/or end user must review all listing information and Dyne’s test results to ensure the proper agent is installed in their equipment and that that agent/equipment is sufficient for their application.

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