



PS-61—2020

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POSITION STATEMENT

TESTING FOR AMMONIA IN CARBON DIOXIDE

Background

Ammonia testing as a limiting characteristic for carbon dioxide exists in several monographs and guidelines for medical, food, and beverage applications.

The rationale behind listing ammonia as an impurity of concern in carbon dioxide is:

- Ammonia manufacturing is one of the feed gas source types used to supply carbon dioxide to purification plants; and
- Ammonia is commonly utilized as a refrigerant when liquifying carbon dioxide in a purification plant.

Question

Is it necessary to test carbon dioxide for the presence of ammonia?

Answer

No, ammonia cannot exist in liquid carbon dioxide in manufacturing and storage because it would chemically form a precipitate(s) with carbon dioxide.

NOTE—Only under certain laboratory conditions can ammonia be artificially added to, and detected in, gaseous carbon dioxide. Even under these unusual circumstances, ammonia is only found at very low part per million concentrations.

NOTE—Ammonia testing may still be required to meet contractual agreements or existing regulatory requirements.

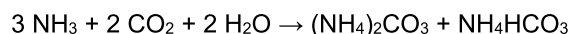
Reasons

Ammonia and carbon dioxide will form the following solid precipitates conditional on the absence or presence of water.

In the absence of water, ammonium carbamate will be formed per the following reaction:



In the presence of water, ammonium carbonate and ammonium bicarbonate will be formed per the following reaction:



In either case, if ammonia was present in the carbon dioxide feed stock or was introduced due to an ammonia refrigeration system leak in the heat exchanger, the above precipitates would be formed and then captured by unit operations (e.g., oil coalescer and coalescing filters, compressor and suction strainers, carbon beds, high pressure water scrubber, drier beds, dust filters, etc.). If these unit operations become saturated with the precipitate, the process flow would be obstructed rendering the plant inoperable.

Further along the supply chain, at most depot and customer storage tanks, a supplemental refrigeration system is utilized for pressure management. Most of these storage tank refrigeration systems do not use ammonia as a refrigerant for cooling. However, if ammonia is used and a rupture occurs in the refrigeration system, the precipitate would form in the refrigeration loop and render the system inoperable. The resulting lack of refrigeration would lead to tank pressure buildup and excessive venting.

Furthermore, ammonia is not introduced throughout the normal carbon dioxide distribution supply.

Any precipitate of ammonium carbamate, ammonium carbonate, or ammonium bicarbonate would exist in its solid state and cannot convert back into ammonia. Ammonia testing is designed to detect gaseous ammonia and not the solid precipitate, therefore testing for ammonia provides no additional assurance of product quality.

Based on this reasoning and the industry's use of a risk-based approach, ammonia testing does not mitigate the perceived risk of ammonia being present in carbon dioxide.

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