



Engineering Sciences Section – 2011

C23 Absorption Refrigerator Fires

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After attending this presentation, attendees will learn the characteristics and modes of failure that cause fires in absorption refrigerators used in the recreational vehicle industry.

This presentation will impact the forensic science community by aiding forensic engineers and fire investigators in the determination whether an absorption refrigerator failed and caused a fire.

Standard refrigerators use a basic process of thermodynamics whereby the cooling process is based on Charles' Law. Absorption refrigerators provide the cooling through evaporation so that the heat is carried away from one material to another that absorb the hot molecules. Absorption refrigerators send the refrigerant, commonly an ammonia product, into a hydrogen gas. As the ammonia evaporates in the presence of the hydrogen gas, the cooling effect is produced. This hydrogen ammonia gas passes through a water containment vessel, which absorbs the ammonia. The water ammonia solution is then heated, which boils the ammonia out of solution. The ammonia gas then condenses back into a liquid so that the liquid ammonia is then sent back through the hydrogen gas and renewing the cycle. At room temperature, ammonia is generally a gas so that it needs to be pressurized in order to turn it into a liquid at room temperature. The typical pressure of the system of an absorption refrigerator is approximately 300 psi.

Sodium chromate is introduced into the closed system to serve as a corrosion inhibitor for the steel tubing and components of the system. Absorption refrigerators are popular in the recreational vehicle industry because the refrigeration cycle can be run through the introduction of electrical or gas heating to boil the ammonia out of solution. This feature allows the refrigerator to be used when electrical shore power is not available at a camp site or while the vehicle is in motion without the use of an electric generator to provide power to the refrigerator. This feature is especially advantageous at camp sites where the use of a generator is prohibited because of the noise and exhaust pollution that would be produced by a generator. The basic components of the absorption refrigerator include an absorber vessel, a liquid temperature exchanger, a boiler, a water separator, a condenser, an evaporator, a gas temperature exchanger, an absorber, and the requisite tubing to connect the components together in a closed cycle.

Attendees will gain experience in the determination of the common mode of failure of these refrigerators that produce fires. Additionally, a simple mode of testing will be discussed in order to determine whether the refrigerator failed and caused the fire.

Absorption Refrigerator, Sodium Chromate, Fire Dynamics