



## Engineering Report

# The Storage of Urea Diesel Exhaust Fluid [UDEF] in CSI Underground Tanks With Test Results

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**03/31/2011**

The use of selective catalytic reduction (SCR) using a 32.5% urea solution in demineralized/deionized or distilled water (urea diesel exhaust fluid [UDEF] also referred to as diesel exhaust fluid [DEF] or aqueous urea solution [AUS 32]), is now being used in the United States to reduce NO<sub>x</sub> emissions from diesel engines. The DEF is injected into the diesel engine exhaust stream. The exhaust stream with DEF then passes through a catalytic convertor where a reaction occurs that eliminates most of the NO<sub>x</sub> from the vehicle exhaust. The system has been in wide use in Europe since 2006.

The quality and handling requirements of the urea solution are specified in ISO 22241. The Petroleum Equipment Institute has also issued a recommended practice for the storage and dispensing of DEF, PEI/RP1100-10.

The purity of the urea DEF is important for the SCR process to work efficiently and for the catalytic convertor to not be fouled. As a result, ISO 22241 part 1, table 1 provides a list of contaminants with limits on the amounts of these contaminants in the urea DEF solution. Part 3 of that same standard also provides a list of recommended materials that can be used to store and handle the urea DEF solution without contamination as well as a list of materials that are not recommended. The storage temperature of DEF is also important as storage at higher temperatures causes deterioration of the DEF solution. ISO 22241 part 3, section 4.2.1 states that prolonged transportation or storage of DEF above 25°C (77°F) should be avoided. The PEI recommended practice follows the ISO purity, handling, and storage temperature recommendations.

Both documents allow for other storage and handling materials to be used only when the manufacturer has tested the material and shown that it is compatible with the urea DEF solution and that the solution will not be contaminated by the material in which it is being stored or handled.

In order to meet the ISO requirement that the manufacturer perform urea DEF testing of materials that are not on the recommended materials list, Containment Solutions contracted with Exova to complete 30, 60, and 90 day testing of CSI fiberglass reinforced plastic (FRP) tank coupons for compatibility with urea DEF. The testing protocol is outlined in the Exova report.

The testing did not detect any organic compounds after 30, 60, and 90 days of exposure. A particulate scan of the 90 day sample found no particulates in the DEF solution from the tank coupon after exposure to DEF. The report concluded that the DEF solution conformed to ISO 22241-2 after 90 days of exposure to the tank coupons.

As a result of this testing, CSI has concluded that CSI underground fiberglass chemical tanks designed to store UDEF will provide satisfactory service storing UDEF that meets the quality and storage requirements in the ISO standard and in the PEI Recommended Practice. UDEF storage tanks are expected to be monitored double wall tanks consistent with the recommendation of the PEI Recommended Practice and with the expectation of the EPA as outlined in their letter dated 09/22/09 which is also a part of the PEI recommended practice.