



UCON™ ULTRAQUENCH™ A Plus Quenchant

Introduction

UCON™ ULTRAQUENCH™ A Plus Quenchant is a nonflammable, aqueous solution of polyalkylene glycol polymer and an enhanced, multi-functional additive package. This product is part of the next-generation series of quenchants now available from The Dow Chemical Company. UCON ULTRAQUENCH Plus Quenchants include a nitrite-free additive package that contains corrosion inhibitors, an antimicrobial and a foam control agent. These products are designed to provide superior corrosion protection for steel, iron, aluminum, brass and copper, and pass both ASTM G 31 and ASTM D 665A. The ULTRAQUENCH Plus products are compatible with traditional UCON and UCON –NN products.

Mechanism of Action

When hot metal is quenched in a diluted solution of UCON ULTRAQUENCH A Plus, the dissolved polymer separates from the water and deposits as a film on the metal surface by the “cloud point” effect. The rate at which the metal is cooled is governed, in part, by the heat transfer properties of the polymer-rich film. The particular heat transfer properties obtained depend on the particular UCON ULTRAQUENCH Plus Quenchant employed, quenchant concentration, agitation rates, and quenchant solution temperature. By adjusting these parameters, a single UCON ULTRAQUENCH Plus Quenchant may be used in a wide variety of heat-treating processes and with a range of metal alloys. Proper selection of these variables permits quenching rate variations, ranging from those achieved with brine solutions to those achieved with medium-to-slow-quenching oils.

A Series of Products to Meet Different Needs

UCON ULTRAQUENCH A Plus is a member of the series of UCON ULTRAQUENCH Plus Quenchants, which all contain a proprietary non-nitrite additive package that provides enhanced corrosion protection, biological and foam control. A Plus, E Plus, RL Plus HT Plus and B Plus are the principal quenchants in the series. These products contain the same polymers found in the traditional nitrite-inhibited UCON Quenchants A, E, RL, and B; they are compatible with their nitrite-containing UCON Quenchant analogs and deliver similar performance.

UCON ULTRAQUENCH A Plus permits the fastest quench rates and facilitates quench uniformity from water to medium-speed quench oils. It can be used to quench both ferrous and non-ferrous metals.

UCON ULTRAQUENCH E Plus Quenchant is useful where the slowest quench rates are desirable. It provides uniform heat transfer in typical oil quenching applications. It is typically used in ferrous metal heat-treating to replace medium- to slow-quenching oils. In non-ferrous applications, this quenchant provides superior distortion-reduction properties for thin sheet products.

UCON ULTRAQUENCH RL Plus Quenchant provides slower quench rates than UCON ULTRAQUENCH A Plus. This product is readily adapted to induction hardening but may be used in other quenching systems as well.

UCON ULTRAQUENCH HT Plus Quenchant is used in applications requiring intermediate quench rates. UCON ULTRAQUENCH HT Plus exhibits higher separation temperature than other members of the series. This allows greater flexibility in the selection of initial bath temperatures and in the permissible run-out temperature during the quench cycle.

Although UCON ULTRAQUENCH A Plus, E Plus, RL Plus and HT Plus are the products of choice for most quenching operations, other UCON Quenchants are also available for specialty heat-treating operations.

Product Description

UCON ULTRAQUENCH A Plus Quenchant is based on the same water soluble polyalkylene glycol polymer that is found in both UCON Quenchants A and A-NN; its quenching performance is analogous to these products. The new, nitrite-free proprietary additive package found in UCON ULTRAQUENCH A Plus provides improved corrosion inhibition, foam and bacterial control. UCON ULTRAQUENCH™ A Plus is compatible with other UCON™ Quenchant A and A-NN products.

Applications

UCON ULTRAQUENCH A Plus is suitable for:

- The heat treatment of carbon and alloy steels by flames, induction and submerged induction heating.
- Batch and continuous furnace operations employing gas-fired and carburizing-carbonitriding atmospheres.
- Wrought, case and forged aluminum alloys.

Advantages and Features

- UCON ULTRAQUENCH A Plus Quenchant has a National Fire Protection Association (NFPA) rating of:
 - Health = 1
 - Flammability = 0
 - Reactivity = 0
- The optimum operating conditions for a specific metal or part may be determined by control of concentration, bath temperature, and/or agitation.
- UCON ULTRAQUENCH A Plus minimizes fluid make-up due to its low deterioration and/or oxidation rate. The major make-up requirement is for water lost by evaporation.
- UCON ULTRAQUENCH A Plus eliminates the smoke, soot and residues common to oil quenchants. Equipment maintenance and plant cleanliness are easier to achieve.
- UCON ULTRAQUENCH A Plus is soluble in water and resistant to bacterial growth.
- UCON ULTRAQUENCH A Plus will freeze below 0°C (32°F). If it is allowed to freeze, it should be thawed to room temperature and mixed before use. The product will not be affected in any way.

Performance

UCON ULTRAQUENCH A Plus is readily adapted to induction and flame hardening, both spray quench and immersion, for such items as gears, crankshafts, camshafts, and other pieces of intricate geometry and difficult metallurgy

UCON ULTRAQUENCH A Plus may follow heating in either oxidizing or protective atmosphere furnaces of batch or continuous design. They may also be used for continuous cast quenching and for general hardening of cast irons and forged and cast steels.

Typical Properties ⁽¹⁾

Weight per Gallon @ 20 °C, lb/gallon	Specific Gravity at 20/20 °C	Flash Point, Cleveland Open Cup, ASTM D 92	Pour Point, °C (°F)	Rust Inhibition, ASTM G 31	Viscosity at 104 °F (40 °C), cSt
9.05	1.085	None	-19 (-1)	Pass	582-740

1. Typical properties, not to be construed as specifications

Cooling Curves

When hot metal is quenched in a diluted solution of UCON ULTRAQUENCH A Plus Quenchant, a film of the liquid organic polymer is deposited on the surface of the hot metal. The film is deposited when the temperature of the solution exceeds the cloud point of polymer. The rate at which the metal is cooled is governed, in part, by the thickness of the polymer-rich film. The thickness of this film is controlled by the concentration of UCON ULTRAQUENCH A Plus in the quench bath.

The cooling rate is also controlled by adjusting the quench bath temperature and/or the rate of agitation.

Figures 1 and 2 illustrate the cooling achieved with UCON ULTRAQUENCH A Plus in laboratory tests using a 750 mm x 12.5 mm Inconel probe fitted with a Type K thermocouple. Figure 1 illustrates temperature and agitation. Figure 2 represents similar data but at multiple bath temperatures. These curves are useful only for a general comparison. The cooling curves for UCON ULTRAQUENCH A Plus will be similar to those of UCON Quenchant A and A-NN under similar test conditions.

Figure 1
Concentration Effect on Cooling and Cooling Rate for UCON ULTRAQUENCH™ A Plus
 Agitation Rate = 15 L/min All Curves are run at 27 °C
 ULTRAQUENCH A Plus Diluted with Deionized Water

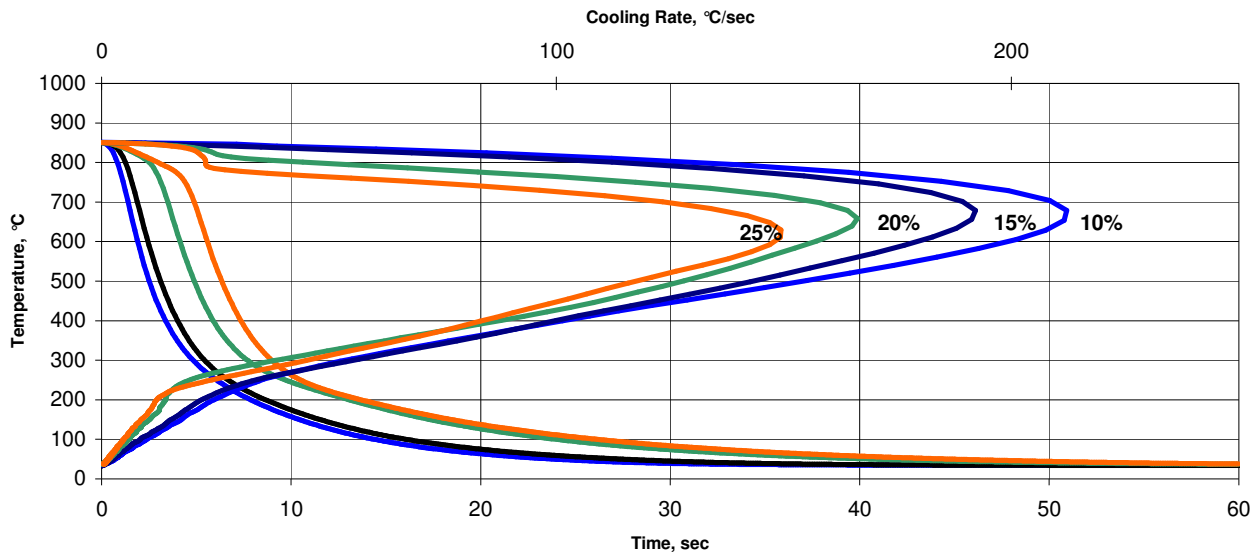
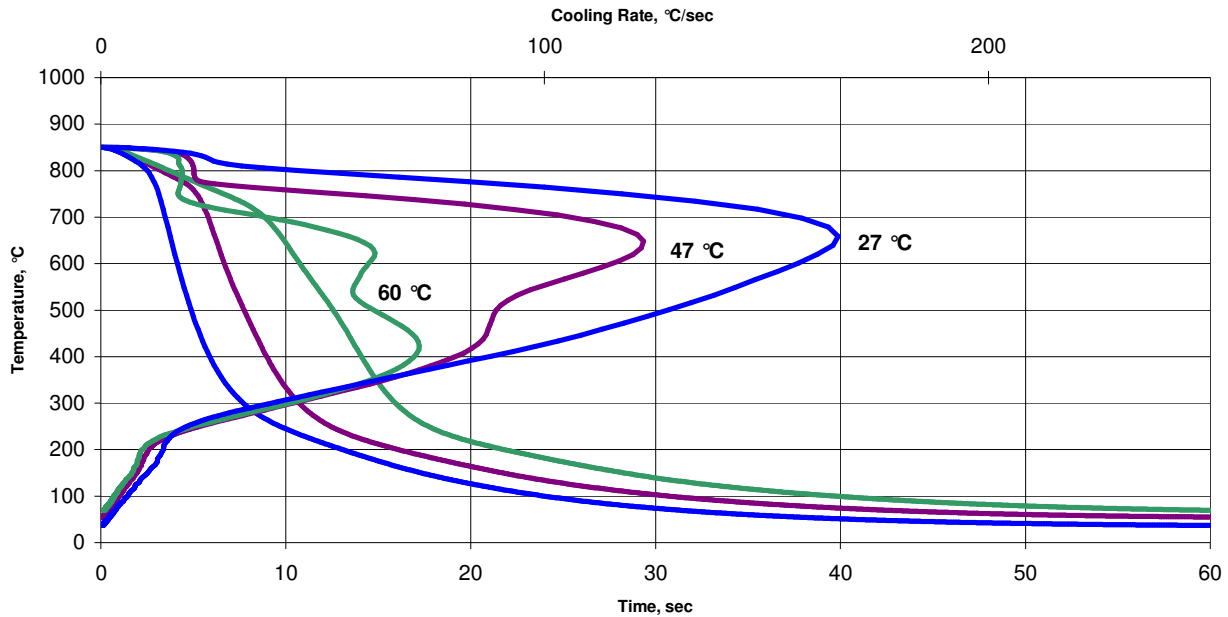


Figure 2

Temperature Effect on Cooling and Cooling Rate for UCON ULTRAQUENCH™ A Plus
 Agitation Rate = 15 L/min
 All Curves are 20% ULTRAQUENCH A Plus Diluted with Deionized Water



Determination of Concentration

Refractive Index

A temperature-compensated, hand-held refractometer is the most convenient tool for daily monitoring of quenchant concentration. The most common models provide arbitrary refractive index readings in Brix units over a 0–30° or 0–15° range. Typically, a drop of the quenchant solution is placed on the prism and the value of the refractive index in Brix units is obtained by looking through the eye piece. The quenchant concentration is determined with the aid of Brix concentration charts (Figures 3 and 4).

Refractive index is relatively insensitive to polymer degradation and is affected by the presence of contaminants such as salt. Therefore, confirmation of quenchant concentration using an alternative procedure such as viscosity must be performed periodically.

Figure 3
 Refractive Index of Dilutions of ULTRAQUENCH A Plus at 20 °C
 Diluted with Deionized Water

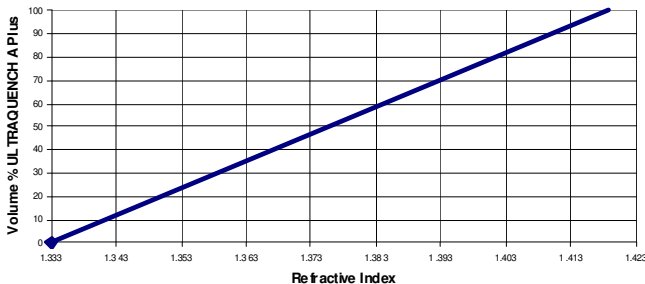
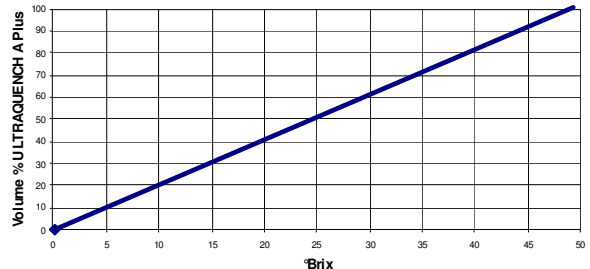


Figure 4
 °Brix of Dilutions of ULTRAQUENCH A Plus at 20 °C
 Diluted with Deionized Water



Viscosity

Quenchant viscosity depends on concentration and is readily determined using a Cannon-Fenske tube, stopwatch and constant temperature bath or by any other method that will measure a reasonably accurate kinematic viscosity. This is an excellent method for measuring polymer concentration, since it is only slightly affected by contamination, but is strongly affected by degradation. Product concentration can be obtained from Figure 5 by comparing the measured viscosity to the appropriate curve on the chart.

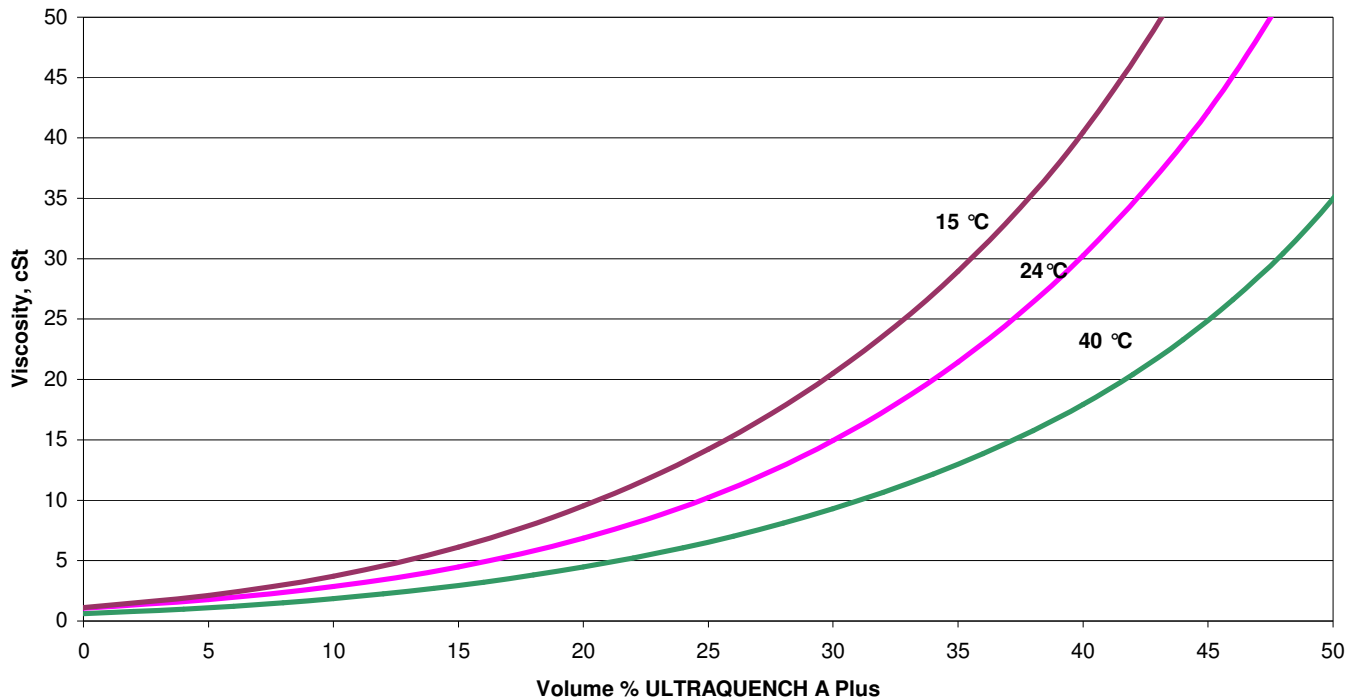
Comparison of Concentration by Refractive Index and Viscosity

To determine if significant polymer degradation or contamination has occurred, it is useful to compare the difference (D) in the quenchant concentration values obtained by the refractive index (C_R) and viscosity (C_V).

$$D = C_R - C_V$$

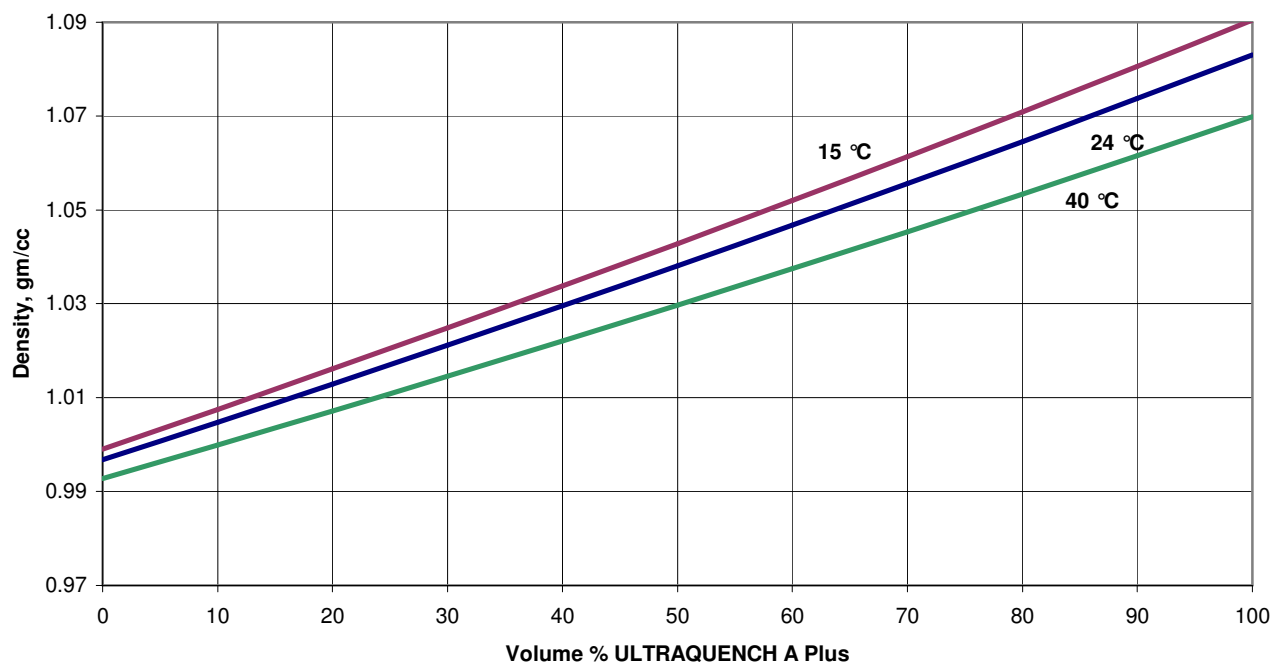
Differences in D of greater than 6–8 are significant and steps should be taken to minimize this difference.

Figure 5
Viscosities of Dilutions of ULTRAQUENCH A Plus at Various Temperatures¹
Diluted with Deionized Water



¹ ASTM D445

Figure 6
Densities of Dilutions of ULTRAQUENCH A Plus at Various Temperatures
Diluted with Deionized Water



**Product Use
Precautions**

Steam and small amounts of organic vapors can be evolved during quenching. The vapors could be irritating and toxic if allowed to accumulate. Adequate workplace ventilation should be provided to prevent irritation and accumulation of vapors; this may require use of a special, local ventilation system in the immediate area where vapors are released.

Where this product is burned under conditions of relatively complete combustion, the major products are carbon dioxide and water vapor. Where this material is subjected to overheating (thermal degradation) but does not burn, the degradation products can be such things as organic acids (formic, acetic acids), aldehydes, esters, ketones, etc. These vapors or fumes can be highly irritating to the eyes, nose, and throat. Special ventilation may be needed. In normal use, no respiratory protective equipment should be needed, but self-contained breathing apparatus should be available for use in emergencies. Small amounts of organic vapors can be formed by oxidation of quenchant. These vapors could be irritating or toxic if released in a poorly ventilated area. Good ventilation should be maintained in the area around quench tanks.

**Product
Stewardship**

Dow encourages its customers and potential users to review their applications from the standpoint of human health and environmental aspects. To help ensure that Dow products are not used in ways for which they are not intended or tested, Dow personnel will assist customers in dealing with environmental and product safety considerations. Dow literature, including Material Safety Data Sheets, should be consulted prior to the use of Dow products.

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