

- [54] **WATER BASED QUENCHING COMPOSITION AND METHOD**
- [75] Inventor: **Robert W. Foreman**, Bloomfield Hills, Mich.
- [73] Assignee: **Park Chemical Co.**, Detroit, Mich.
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|-----------|---------|-----------------------|----------|
| 2,770,564 | 11/1956 | Gordon..... | 148/18 |
| 3,022,205 | 2/1962 | Chase et al. | 148/20.6 |
| 3,220,893 | 11/1965 | Blackwood et al | 148/28 |
| 3,224,910 | 12/1965 | McEwen | 148/28 |
| 3,475,232 | 10/1969 | Lewis et al..... | 148/18 |

Primary Examiner—Walter R. Satterfield
Attorney, Agent, or Firm—Harness, Dickey & Pierce

Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 156,037, June 23, 1971, abandoned.
- [52] **U.S. Cl.**..... **148/28**, 148/18, 252/76, 252/79
- [51] **Int. Cl.**..... **B23k 35/24**
- [58] **Field of Search** 148/18, 25, 28, 19, 29, 148/20.6, 157; 252/73, 76, 79

[57] **ABSTRACT**

A stable quenching composition comprised of an aqueous solution which contains dissolved therein: a water soluble polyvinyl alcohol resin, a solid water soluble polyoxyalkylene compound having a molecular weight from about 1,000 to less than 95,000, with the balance of the composition being water; and, a method of quenching heated metal with the quenching composition disclosed herein.

References Cited

UNITED STATES PATENTS

- 2,600,290 6/1952 Cornell 148/18

3 Claims, No Drawings

WATER BASED QUENCHING COMPOSITION AND METHOD

BACKGROUND OF THE INVENTION

This application is a continuation in part of copending application Ser. No. 156,037, filed June 23, 1971, now abandoned.

This invention broadly relates to a new quenching composition and a method of quenching heated metal using said composition.

In the past it has been known to utilize a water solution of polyvinyl alcohol resin as an aqueous quenching composition (Corneil U.S. Pat. No. 2,600,290), and while such compositions are still useful in various applications at the present time, they also possess a serious disadvantage due to their tendency to form a tenaciously adherent film on the hot worked metal following quenching. Thus there has been a clear need in the art for many years for an aqueous quenching composition which would not leave the tenacious film on the hot worked metal after quenching and which at the same time would be economical to produce so that it would receive acceptance in the market place.

Accordingly it is an object of this invention to provide an improved aqueous quenching composition which is economically advantageous to produce.

Another object of the present invention is to provide a new aqueous quenching composition which does not leave a tenacious film on the hot worked metal after quenching.

Another object of the present invention is to provide an improved aqueous quenching composition which possesses excellent quenching properties for steel parts and also for aluminum parts, and which is considerably more economical to produce than previously known aqueous quenching compositions.

Another object of the present invention is to provide an improved aqueous quenching composition and a concentrated form thereof, which composition and concentrate are highly stable and do not have the ingredients thereof separated out after substantial periods of shelf-life.

Another object of the present invention is to provide an improved method of quenching heated metal utilizing a quenching composition as discovered and disclosed herein.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims.

The state of the art is indicated by the following references, and which are cited here of record: Lewis et al U.S. Pat. No. 3,475,232; Corneil U.S. Pat. No. 2,600,290; Gordon U.S. Pat. No. 2,770,564; Erdmann U.S. Pat. No. 2,793,147; 1 Freeman U.S. Pat. No. 2,799,606; Bailey U.S. Pat. No. 2,914,491; Chase et al U.S. Pat. No. 3,022,205; Blackwood et al U.S. Pat. No. 3,220,893; British Pat. No. 716,354. Said patent disclosures are hereby incorporated herein by reference.

SUMMARY OF THE INVENTION

Briefly stated the present invention comprises a water based quenching composition which includes water soluble polyvinyl alcohol resin, a solid water soluble polyoxyalkylene compound having a molecular weight from about 1,000 to less than 95,000, a coupling agent, and the balance water.

From a method aspect, briefly stated, the present invention comprises a method of quenching heated metal comprised of contacting the heated metal with an aqueous quenching solution comprising water having dissolved therein a water soluble polyvinyl alcohol resin and a solid water soluble polyoxyalkylene compound having a molecular weight from about 1,000 to less than 95,000.

In accordance with the invention disclosed herein it has now been discovered that the amount of film formation is insignificant when quench compositions containing less than 5 percent and preferably less than about 2 percent by weight non-aqueous solids or non-volatiles are used as is normally the case, whereas, prior art quenching compositions form a hard varnish like film that is extremely difficult to remove.

It has also been found that the composition disclosed in this invention is highly stable and has a long shelf-life which is highly desirable, and in fact highly necessary in order to obtain commercial acceptance in the market place.

The composition of this invention is also more economical to produce and has a more effective quenching rate than the patents above. The composition of this invention is a more effective quench retardant, because the composition is unique in that a less concentrated solution is required in order to effectively slow down the quench in comparison with prior water based aqueous quenching compositions.

It has also been found that the inventive composition disclosed herein is unexpectedly advantageous for use in aluminum quenching in comparison with prior art compositions, in that the composition disclosed herein produces equal hardnesses, using a less concentrated quenching solution, with equivalent distortion and with less film formation in comparison with the prior art water based quenching compositions.

Compatibility and storage tests of formulations made in a manner similar to the composition of the present invention using a polyglycol material (in place of the specific polyoxyalkylene material discovered for use in connection with the present invention) as in U.S. Pat. No. 3,220,893 show that the concentrated compositions made in this manner are unstable. Also, when a polyol material having a molecular weight of approximately 100,000 was attempted for use in the composition of the present invention, as disclosed in U.S. Pat. No. 3,022,205, storage and compatibility tests also showed that the formulation so attempted was unstable.

Hardenability and quenching tests run with the composition of this invention on SAE 1045 steel parts, SAE 4140 steel parts and aluminum alloy material 6061, have shown that the quenching composition of this invention is superior to prior art water based quenching compositions in ability to retard the quench.

Work on oil hardening type steels, such as SAE 4150 and SAE 5150, have shown that the quenching composition of this invention used in an amount equaling about 2 percent by weight non-aqueous solids, will produce oil like hardnesses with no quench cracking depending on the size of the sample parts quenched.

The materials used in the inventive composition herein are such that a much lower percentage of non-aqueous solids is required to retard the quench to the same degree as would be necessary with other water based quenching compositions. Based on this discovery

it is possible with the composition of this invention to utilize a water based quenching composition which behaves like and closely approximates an oil quenching composition. The quenching composition of this invention also effectively bridges the gap between oil quenching compositions and water-based compositions.

The times in seconds to quench from 1500°F to the following temperatures relative to the difference from H₂O, provides the following:

| Temp. Change To: | Times in Seconds (Increase Over H ₂ O) | | |
|------------------|---|-----------------------------------|--------------|
| | % Non-Volatile Solids | | |
| | 0.55% Ex. No. Comp. Hereinbelow | 1.38% Ex. No. 2 Comp. Hereinbelow | 2.5% Ucon A* |
| 900° F | 0.36 | 0.40 | 0 |
| 600° F | 1.06 | 1.46 | 0.50 |
| 300° F | 1.35 | 2.61 | 0.50 |

* Blackwood Patent No. 3,220,893 Commercial Material

In aluminum quenching the dragout carryover is approximately 50 percent less using the composition of this invention in comparison with prior art water based compositions. Water based quenching compositions are commonly used in the aircraft and associated industries in quenching aluminum heat treatable alloys such as aluminum alloy 6061, followed by aging at room temperature (natural aging) or precipitation hardening (artificial aging) producing what are known as T4 and T6 heat treated conditions respectively. In such an application as this the water based quenching composition of the present invention is highly advantageous over prior art compositions in that the composition of this invention provides a rapid quench while still minimizing quench distortion.

DESCRIPTION OF PREFERRED EMBODIMENTS

The polyvinyl alcohol resin which is utilized in the invention must be a water soluble resin and broadly it should be present within the range of about 0.02 percent to less than 2.7 percent by weight of the quenching composition.

The solid water soluble polyoxyalkylene compound which has been discovered for use in accordance with the invention herein should be a polyoxyalkylene material having a molecular weight from about 1,000 to less than 95,000. Preferably this molecular weight should be within the range of about 2,000 to about 50,000 and best results are obtained using a material having a molecular weight within the range of about 2,000 to about 16,000. Suitable polyoxyalkylene compounds for use in the present invention may be prepared as described in U.S. Pat. No. 2,674,619, the disclosure of which is incorporated herein by reference. It is preferred that the polyoxyalkylene material be one in which the hydrophobic element of the compound is a polypropylene polymer. It has been discovered to be important in order to achieve the benefits of this invention that the polyoxyalkylene compound be a solid water soluble material.

The amount of the polyoxyalkylene compound used in the inventive composition should broadly be within the range of about 0.01 to less than 1.8 percent by weight of the quenching composition.

The coupling agent which is used in this invention should have a molecular weight of less than 900; and, may be any one of a number of different materials such as ethylene glycol, ethyl butyl cellosolve, diethylene glycol ethyl ether, carbitol, propylene glycol, and dipropylene glycol.

The amount of the coupling agent used in the composition herein should normally be at a level of about 0.01 percent by weight of the composition or higher. Preferably the coupling agent may be present within the range of about 0.01 to about 5 percent by weight of the composition.

In accordance with the inventive composition discovered and disclosed herein it is also in many instances desirable to include in the composition additives such as a rust inhibitor material, a stabilizer material, and/or additives to prevent bacterial growth and odors.

In order to further illustrate the invention, the following Examples are provided. It is to be understood, however, that the Examples are included for illustrative purposes and are not intended to be limiting of the scope of the invention as set forth in the subjoined claims.

EXAMPLE 1

A concentrate (in weight percent) of 90 percent water, 5 percent water soluble polyvinyl alcohol resin (e.g., Elvanol 50-42 supplied by duPont), and 5 percent solid water soluble polyoxyalkylene (Pluronic F 68 LF supplied by Wyandotte Chemical Company) is prepared by simple mixing and stirring of the ingredients. This is diluted 9:1 with water and thoroughly mixed. SAE 1045 steel bar stock is heated to 1000° F in a cyanide/cyanate casing salt and quenched into the diluted quenchant. The steel is quenched without cracking and without leaving an adherent film.

EXAMPLE 2

| Material | Parts by Weight |
|----------------------|-----------------|
| (a) Water | 85.70 |
| (b) Pluronic F 68 LF | 4.70 |
| (c) Elvanol 50-42 | 7.10 |
| (d) Carbitol | 2.0 |

Dilute with water to desired percent non-volatiles of (b), (c) and (d).

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A water based quenching composition consisting essentially of in weight percent:

- about 0.02 to 2.7 percent water soluble polyvinyl alcohol resin,
- about 0.01 to 1.8 percent solid water soluble polyoxyalkylene compound having a molecular weight from about 1,000 to less than 95,000,
- at least about 0.01 up to about 5 percent coupling agent for preventing separation between components (a) and (b), said coupling agent having a molecular weight of less than 900 and being different than components (a) and (b) and being selected from at least one material of the group consisting

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of ethylene glycol, ethyl butyl cellosolve, diethylene glycol ethyl ether, carbitol, propylene glycol, and dipropylene glycol, and the balance water,

said composition having a percent total non-volatile solids of less than 5 percent by weight of the composition.

2. A method of quenching heated metal comprised of contacting the heated metal with a water based quenching composition consisting essentially of in weight percent:

- a. about 0.02 to 2.7 percent water soluble polyvinyl alcohol resin,
- b. about 0.01 to 1.8 percent solid water soluble polyoxyalkylene compound having a molecular weight from about 1,000 to less than 95,000,
- c. at least about 0.01 up to about 5 percent coupling

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agent for preventing separation between components (a) and (b), said coupling agent having a molecular weight of less than 900 and being different than components (a) and (b) and being selected from at least one material of the group consisting of ethylene glycol, ethyl butyl cellosolve, diethylene glycol ethyl ether, carbitol, propylene glycol, and dipropylene glycol, and the balance water,

said composition having a percent total non-volatile solids of less than 5 percent by weight of the composition.

3. The composition of claim 1 wherein, said molecular weight of the solid polyoxyalkylene compound is between about 2,000 and about 16,000.

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