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METAL QUENCHING MEDIUM

This application is a divisional of application Ser. No. 11/429,784, filed May 8, 2006, abandoned, which claims benefit under 35 USC 119(e) of U.S. provisional app. No. 60/679,485, filed May 10, 2005, which applications are incorporated by reference.

The present invention is aimed at providing a metal quenching medium. The aqueous medium may be used to quench for example steel and aluminum alloys. The aqueous medium comprises a terpolymer of i) acrylamide and/or methacrylamide, ii) acrylic acid and/or methacrylic acid and iii) one or more hydrophobic alkyl alkoxyate allyl ethers.

BACKGROUND OF THE INVENTION

Significant efforts have been invested in developing aqueous quenching media. Such aqueous quenching media, or quenchant media, comprise water compatible polymers, for example starch, alkylene oxide polymers or polyacrylates.

Such quenching media are disclosed for example in U.S. Pat. Nos. 6,689,227, 4,381,205 and 5,766,505.

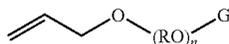
U.S. Pat. Nos. 3,939,016 and 3,996,076 teach the use of a aqueous quenching medium that comprises polyacrylic acid, polymethacrylic acid, a copolymer of acrylic acid and methacrylic acid or a salt thereof.

Surprisingly, it has been found that certain hydrophobically modified polyacrylate copolymers provide for an excellent aqueous metal quenching medium.

SUMMARY OF THE INVENTION

Disclosed is a quenching medium for treating a heated metal part, said medium comprising water and

a polyacrylate terpolymer comprising acrylamide and/or methacrylamide monomer units, acrylic acid and/or methacrylic acid monomer units and alkyl alkoxyate allyl ether monomer units, where the acid groups are in the form of an alkali metal salt and where the alkyl alkoxyate allyl ether monomers are of the formula

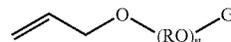


where n is an integer from 1 to about 30, R is ethylene, propylene or butylene and G is an alkyl group of 8 to 30 carbon atoms.

Also disclosed is a process for quenching a heated metal part, which process comprises preparing a quenching medium comprising

water and a polyacrylate terpolymer comprising acrylamide and/or methacrylamide monomer units, acrylic acid and/or methacrylic acid monomer units and alkyl alkoxyate allyl ether monomer units, where the acid groups are in the form of an alkali metal salt and where the alkyl alkoxyate allyl ether monomers are of the formula

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where n is an integer from 1 to about 30, R is ethylene, propylene or butylene and G is an alkyl group of 8 to 30 carbon atoms and

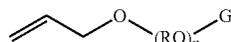
immersing the heated metal part in the quenching medium for a period of time to accomplish the quenching.

Also disclosed are the polyacrylate terpolymers. In the polyacrylate terpolymers, the acid groups are in the acid form or are in the form of an alkali metal salt.

DETAILED DISCLOSURE

The alkyl alkoxyate allyl ethers are for example alkyl ethoxyate allyl ethers, alkyl propoxyate allyl ethers, alkyl butoxyate allyl ethers or are mixtures of alkoxyates.

The alkyl alkoxyate allyl ether monomers are represented as



and are hydrophobically modified by virtue of the group G, an alkyl group of 8 to 30 carbon atoms.

Ethylene is 1,2-ethylene. Propylene is 1,2- or 1,3-propylene. Butyl is 1,2-, 1,3- or 1,4-butylene.

Alkyl is straight or branched chain. Alkyl is for example 1,1,3,3-tetramethylbutyl, 1-methylheptyl, 3-methylheptyl, n-octyl, 2-ethylhexyl, 1,1,3-trimethylhexyl, 1,1,3,3-tetramethylpentyl, nonyl, decyl, undecyl, 1-methylundecyl, dodecyl, 1,1,3,3,5,5-hexamethylhexyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, icosyl, docosyl and so on.

For example, R is 1,2-ethylene, n is an integer from about 10 to about 20 and the alkyl group G has 12 to 24 carbon atoms. For example, the group G is stearyl. For example, the alkyl alkoxyate allyl ethers are 10 mol (n=10) ethoxyates or are 20 mol ethoxyates.

The weight:weight ratio of acrylamide and/or methacrylamide:acrylic acid and/or methacrylic acid monomer units in the terpolymer is from about 9:1 to about 1:9, for example from about 7:1 to about 1:7, from about 5:1 to about 1:5, from about 4:1 to about 1:4, from about 3:1 to about 1:3 or is from about 2:1 to about 1:2. For instance, the weight:weight ratio of acrylamide and/or methacrylamide:acrylic acid and/or methacrylic acid monomer units is from about 2:1 to about 3:1.

The alkyl alkoxyate allyl ether monomer units make up to about 25 weight % of the monomer units of the terpolymer, for example up to about 15%, up to about 12%, up to about 10%, or up to about 5 weight %.

Examples of the make-up of the terpolymer, by weight, are 65:30:5 acrylamide:acrylic acid:alkyl alkoxyate allyl ether and 20:70:10 acrylamide:acrylic acid:alkyl alkoxyate allyl ether. Acrylamide and acrylic acid may be partially or fully substituted by methacrylamide and methacrylic acid respectively.

The acrylic acid units of the terpolymer are in the form of an alkali metal salt, via neutralization with an alkali metal hydroxide. The alkali metal is for example sodium or potassium.