Title: ANTI-SPATTER FORMULATION

Abstract: The present invention provides an anti-spatter formulation comprising one or more fats, oils, fatty acids, and/or triglycerides, an aqueous phase carrier and optionally one or more surfactants, and/or one or more stabilisers, such that the formulation exhibits relatively low toxicity and/or relatively enhanced efficacy in reducing the amount of welding spatter adhering to a welding instrument and/or a metal surface upon which welding is effected. Preferably, the anti-spatter formulation is an emulsion. The invention also provides a method of applying an effective amount of such an anti-spatter formulation to a metal surface; a method of substantially reducing weld spatter; a method of preparing such an anti-spatter formulation; and such an anti-spatter formulation, when prepared by such a method.
ANTI-SPATTER FORMULATION

Field of the Invention

The present invention relates to a formulation suitable for use as a protective anti-spatter coating and/or tip coating for welding apparatus, and will be described hereinafter with reference to such applications. However, those skilled in the art will appreciate that the invention is not in any way limited to these particular fields of use.

The formulation (hereinafter referred to as the "product") consists in an oil-in-water emulsion (for the anti-spatter product), or a water-in-oil emulsion (for the tip protective coating) made from a combination of fats, oils, fatty acids and/or triglycerides, with one or more surfactants and other optional or preferable materials, thereby affording itself for use with MIG and Electric Arc welding apparatus.

Background of the Invention

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

Anti-spatter formulations are widely used by welders and metalworkers to prevent welding spatter from sticking either to their work and/or the tip of their welding instrument whilst welding with either MIG or Electric Arc apparatus. MIG (Metal Inert Gas) welding is often called Wire-feed, or GMAW (Gas Metal Arc Welding). The "Metal" refers to the wire used to start the arc, which is shielded by inert gas. The feed wire also acts as the filler rod in a semi-automatic process.
In addition, gels are routinely applied to welding tips to prevent spatter deposition. Current methods of application of anti-spatter formulations include; spraying, dip-coating or flow-coating the formulation on to the metal surface and/or the welding tip. Anti-spatter formulations are usually applied prior to initiating welding, as they help in reducing the time required to remove weld spatter by inhibiting the spatter from adhering to the surface of the metal being welded. Anti-spatter formulations may be based on solvent and/or aqueous solutions.

Solvent-based anti-spatter formulations may pose handling problems for the workers using these products due to the toxicity and/or flammability of the solvents employed. The principal benefit of aqueous-based formulations is the reduction of toxicity and flammability. To the best of the Applicants' knowledge, most known aqueous anti-spatter formulations still contain constituents which may be considered toxic and flammable, which in turn becomes a potential hazard for workers involved in the manufacturing of such products. Safety measures generally have to be put in place to overcome these handling issues, which in turn adds to the cost of manufacturing.

Anti-spatter formulations applied to a surface using aerosol or spray packs have the added health risk that the airborne residual, which may contain toxic constituents can enter the body of the user via the lungs, skin or mucosa.

Aqueous-based formulations can also exist as suspensions; such formulations contain insoluble solids, which require a suspending agent in order to keep the solids from settling out. The suspending agent also keeps the solids relatively evenly dispersed within the formulation, thereby allowing for a relatively even distribution of the solid upon application. When such a formulation does not contain a suspending agent, the solid material can sediment; such formulations require vigorous shaking in
order to redisperse the solid throughout the liquid. Suspensions that do not contain a suspending agent can embody the added risk of an uneven distribution of the solid in the liquid phase upon application. The presence of solid materials in either suspending agent or non-suspending agent suspensions has the added disadvantage in that the solids may clog spray nozzles, which can limit their use in aerosol or spray packs. Another problem, which can be faced using such formulations, is that they may leave a residue behind on the surface, which may require cleanup, again adding time and labour-intensity to a welding job.

Anti-spatter formulations can also take the form of emulsions, which are typically droplets of one immiscible liquid held in a suspension of another. It is desirable to form droplets that are as small as possible since the rate of creaming (i.e., the rate at which the immiscible phases separate) increases with droplet size. Surface-active agents (or "surfactants") are used to lower the surface energy of the immiscible liquids thus promoting the formation of desirous smaller droplets. Surfactants can also help reduce the rate of coalescence. Desirable droplet sizes are around 100 nm or less; emulsions with such bubble sizes are sometimes referred to as "microemulsions" whereas emulsions having droplet sizes of around 1 µm are sometimes referred to a "macroemulsions".

Representative anti-spatter formulations include that disclosed in JP 59150666, in which an anti-spatter agent containing zirconium oxide or a zirconium compound forming zirconium oxide when heated as an effective component is defined. The reason for using zirconium oxide or a zirconium compound lies in that the zirconium oxide has a high melting point and does not change physically at the temperatures generated in welding and that the zirconium oxide has the same coefficient of thermal expansion as
metals and that when the zirconium is coated on a steel plate, the coated film thereof has good adhesion. The zirconium oxide has relatively small affinity to metals, and has weak adhesion power to a molten metal so that the removal thereof is easy. The zirconium compound stabilises the arc and permits easy formation of slag. The zirconium compound is exemplified by zirconium hydroxide, basic zirconium carbonate, zirconium stearate, etc. The zirconium oxide or zirconium compound is used by applying another inorganic pigment according to need in 50-90% w/w zirconium oxide or zirconium compound, compounding water, a solvent and a synthetic resin therewith and preparing the mixture into a paste or paint form. It will be readily appreciated that such a formulation is both toxic and relatively cumbersome.

Japanese Patent No. JP 58041693 provides a high effect of preventing sticking of spatters on the nozzle, etc. of welding torches by consisting a titled agent of a solvent having a specific boiling point and solid lubricant powder. Specifically, a solvent having a b.p. of 130-300 °C such as butyl cellulosolve, cyclohexanone, or the like, and boron nitride as solid lubricant powder are used as essential components, and a solvent which evaporates preferentially to the solvent at 130-300 °C is compounded with these components. Such compound is coated on the nozzle and tip of welding torches and jig, etc., and in the stage of coating, the volatile solvent is allowed to evaporate preferentially, thereby forming the coating layers substantially of the solvent of b.p. 130-300 °C and the solid lubricant powder. After the solvent of b.p. 130-300 °C evaporates by arc heat, the deposited layer of the solid lubricant powder is dense and firm and retains the effect of preventing sticking of spatters. Those skilled in the art will readily appreciate that such a formulation is both toxic and relatively cumbersome.
Other means of limiting welding spatter include specifically designed attachments or adornments upon the welding apparatus. These are necessarily bulky, cumbersome, heavy and negatively impact upon the field of vision a welder is able to experience when conducting a job.

The toxicity of the current formulations has driven the need to make efforts to reduce the level of toxic constituents used in anti-spatter formulations.

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

It is an object of certain preferred forms of the present invention to provide formulations that substantially eliminate or reduce spatter for use with MIG and Electric Arc welding apparatus. The inventive formulations consist in an oil-in-water emulsion (for an anti-spatter product), or a water-in-oil emulsion (for a tip protective coating) made from a combination of fats, oils, fatty acids and/or triglycerides, with one or more surfactants and other optional or preferable materials.

Summary of the Invention

According to a first aspect of the present invention there is provided an anti-spatter formulation comprising:

- one or more fats, oils, fatty acids, and/or triglycerides;
- an aqueous phase carrier; and
- optionally, one or more surfactants, and/or one or more stabilisers,

said formulation thereby exhibiting relatively low toxicity and/or relatively enhanced efficacy in reducing the amount of welding spatter...
adhering to a welding instrument and/or a metal surface upon which welding is effected.

Preferably, the formulation comprises:

- 0.001-99.999% w/v of said one or more fats, oils, fatty acids and/or triglycerides;
- 0.001-99.999% w/v of said aqueous carrier phase;
- 0-80% w/v of said one or more surfactants; and
- 0-10% w/v of said one or more stabilisers.

More preferably, the formulation comprises:

- 0.01-99.99% w/v of said one or more or a combination of fats, oils, fatty acids and/or triglycerides;
- 0.01-99.99% w/v of said aqueous carrier phase;
- 0.01-80% w/v of said one or more surfactants;
- 0-80% w/v of one or more organic solvents;
- 0-5% w/v of one or more corrosion inhibitors; and
- 0-5% w/v of one or more antimicrobial agents;

Preferably, the formulation further comprises 0.01-10% w/v of said one or more stabilisers. Preferably, aqueous carrier phase is water. Preferably, the formulation is a microemulsion or a macroemulsion.

Preferably, said fats, oils, fatty acids and/or triglycerides comprise one or more C_4^-C_{24} fatty acids. More preferably, said C_4^-C_{24} fatty acids are selected from the group consisting of: almond oil, beef tallow, butterfat (cow and/or goat), canola oil, cocoa butter, cod liver oil, coconut oil, corn oil, cottonseed oil, flaxseed oil, grape seed oil,
lard (pork fat), olive oil, palm oil, palm olein, palm kernel oil, peanut oil, safflower oil, sesame oil, soybean oil, sunflower oil and walnut oil.

Preferably, said one or more surfactants are selected from the group consisting of: non-ionic, anionic, cationic, polymeric and amphoteric surfactants. More preferably, said one or more non-ionic surfactants are selected from the group consisting of: sorbitan fatty acid ester ethoxylates, sorbitan fatty acid esters C_8-C_{10} alkylphenol ethoxylates, C_{8}-C_{17} alcohol ethoxylates, C_8-C_{20} alkyl amine ethoxylates, castor oil ethoxylates, lanolin alcohol ethoxylates and mixtures thereof.

More preferably still, said one or more non-ionic surfactants are selected from the group consisting of: alkyl polysaccharides, alkyamine ethoxylates, amine oxides, block copolymers, castor oil ethoxylates, ceto-oleyl alcohol ethoxylates, ceto-stearyl alcohol ethoxylates, decyl alcohol ethoxylates, dinonyl phenol ethoxylates, dodecyl phenol ethoxylates, end-capped ethoxylates, ethoxylated alkanolamides, ethylene glycol esters, fatty acid alkanolamides, fatty alcohol alkoxylates, lauryl alcohol ethoxylates, mono-branched alcohol ethoxylates, nonyl phenol ethoxylates, octyl phenol ethoxylates, random copolymer alkoxylates, sorbitan ester ethoxylates, stearic acid ethoxylates, synthetic alcohol ethoxylates, tall oil fatty acid ethoxylates, tallow amine ethoxylates and mixtures thereof.

Preferably, said one or more anionic surfactants are selected from the group consisting of: alkyl ether phosphates, alkyl phenol ether phosphates, alkyl phenol ether sulfates, alkyl naphthalene sulfonates, condensed naphthalene sulfonates, aromatic hydrocarbon sulfonic acids, salts and blends, fatty alcohol sulfates, alkyl ether carboxylic acids and salts, alkyl ether sulfates, mono-alkyl sulfosuccinamates, di-alkyl sulfosuccinates, alkyl phosphates, alkyl benzene sulfonic acids and salts, alpha olefin
sulfonates and mixtures thereof.

 Preferably, said one or more amphoteric surfactants are selected from the group consisting of: alkyl ampho(di)acetates, amido betaines, alkyl betaines and mixtures thereof.

 Preferably, said one or more cationic surfactants are selected from the group consisting of: alkyl dimethlamines and alkyl amidopropylamines, quaternised amine ethoxylates, quaternary ammonium compounds and mixtures thereof.

 Preferably, said one or more polymeric surfactants are selected from the group consisting of: comb-graft copolymer, condensed naphthalene sulfonates, polycarboxylates and mixtures thereof.

 Preferably, said one or more stabilisers are selected from the group consisting of: silicone dioxide, magnesium aluminium silicate, montmorillonite clay, xanthan gum, heteropolysaccharide, glycercytr-12-hydroxystearate, hydroxy propyl methyl cellulose and mixtures thereof.

 Preferably, said one or more corrosion inhibitors are selected from the group consisting of: salts and/or esters of nitric acid and salts and/or esters of boric acid. More preferably, said salts and/or esters of nitric acid and salts and/or esters of boric acid are selected from the group consisting of: ammonium nitrate, potassium nitrate, sodium nitrate, ammonium borate and sodium borate. More preferably still, said salt of nitric acid is sodium nitrate. Preferably, said antimicrobial agent is Zeomic.

 Preferably, said aqueous carrier phase is present in an amount of about 10% w/v; said organic carrier phase is present in an amount of about 80% w/v; and said one or more surfactants are present in an amount of about 10% w/v.
Preferably, said composition is an anti-spatter formulation comprising the following approximate proportions: water 95.38, palm oil 4.00, palm oil ethoxylate 0.50, xanthan gum 0.10, sodium nitrate 0.01, zeomic 0.01% w/v.

Preferably, said composition is an anti-spatter formulation comprising the following approximate proportions: water 97.39, olive oil 2.00, castor oil ethoxylate 0.50, montmorillonite clay 0.10, sodium borate 0.01% w/v.

In an embodiment, the relative amount of said organic phase is increased relative to the amount of said aqueous carrier phase.

Preferably, said aqueous carrier phase is suspended in said organic carrier phase, with the relative amounts thereof selected such that said formulation is a gel for acting as a protective coating for the tip of said welding instrument.

Preferably, said aqueous carrier phase is present in an amount of about 95% w/v and said organic carrier phase is present in an amount of about 4% w/v.

Preferably, said composition is a welding tip protector formulation comprising the following approximate proportions: water 9.88, palm oil 80.00, palm oil ethoxylate 10.00, xanthan gum 0.10, sodium nitrate 0.01, zeomic 0.01% w/v.

Preferably, said composition is a welding tip protector formulation comprising the following approximate proportions: water 14.88, olive oil 82.00, castor oil ethoxylate 3.00, montmorillonite clay 0.10, sodium borate 0.01, zeomic 0.01% w/v.

According to a second aspect of the present invention there is provided a method of applying an effective amount of an anti-spatter formulation according to the first aspect of the present invention to a metal surface, said method comprising:

spraying, dip coating, flow coating, or a combination thereof.
According to a third aspect of the present invention there is provided a method for preventing or substantially reducing spatter in welding, said method comprising applying a formulation according to the first aspect of the present invention to a welding apparatus and/or a surface to be welded.

According to a fourth aspect of the present invention there is provided a method of preparing an anti-spatter formulation, said method comprising the steps of:

I. preparing an organic carrier phase solution comprising one or more or a combination of fats, oils, fatty acids or triglycerides; and

II. adding an aqueous carrier phase to said organic carrier phase.

Preferably, said organic carrier phase is within the temperature range 15-80 °C. More preferably, said organic carrier phase is within the temperature range 40-60 °C.

Preferably, said aqueous carrier phase is within the temperature range 15-80 °C. More preferably, said aqueous carrier phase is within the temperature range 40-60 °C.

Preferably, one or more surfactants are added to said organic carrier phase and/or said aqueous carrier phase prior to step II. Preferably, one or more solvents are added to said organic carrier phase and/or said aqueous carrier phase prior to step II.

Preferably, said formulation is a microemulsion or a macroemulsion. Preferably, said aqueous carrier phase is added to said organic carrier phase in incremental portions until the desired said microemulsion or said macroemulsion has been formed.

Preferably, once said macroemulsion is formed, said one or more stabilisers are added whilst said macroemulsion is being homogenised. Alternatively, once said macroemulsion is formed, said one or more stabilisers are added once said macroemulsion is homogenised.
Preferably, one or more antimicrobial agents and/or one or more corrosion inhibitors are added to said aqueous carrier phase and/or said organic carrier phase.

Preferably, one or more antimicrobial agents and/or one or more corrosion inhibitors are added to said microemulsion or said macroemulsion once formed.

Preferably, said fats, oils, fatty acids and/or triglycerides comprise one or more C₄-C₂₄ fatty acids. More preferably, said one or more C₄-C₂₄ fatty acids are selected from the group consisting of: almond oil, beef tallow, butterfat (cow and/or goat), canola oil, cocoa butter, cod liver oil, coconut oil, corn oil, cottonseed oil, flaxseed oil, grape seed oil, lard (pork fat), olive oil, palm oil, palm olein, palm kernel oil, peanut oil, safflower oil, sesame oil, soybean oil, sunflower oil and walnut oil.

Preferably, said one or more surfactants are selected from the group consisting of: non-ionic, anionic, cationic, polymeric and amphoteric surfactants.

Preferably, said one or more non-ionic surfactants are selected from the group consisting of: sorbitan fatty acid ester ethoxylates, sorbitan fatty acid esters C₈-C₁₀ alkylphenol ethoxylates, C₈-C₁₇ alcohol ethoxylates, C₈-C₂₀ alkyl amine ethoxylates, castor oil ethoxylates, lanolin alcohol ethoxylates and mixtures thereof.

Preferably, said one or more non-ionic surfactants are selected from the group consisting of: alkyl polysaccharides, alkylamine ethoxylates, amine oxides, block copolymers, castor oil ethoxylates, ceto-oleyl alcohol ethoxylates, ceto-stearyl alcohol ethoxylates, decyl alcohol ethoxylates, dinonyl phenol ethoxylates, dodecyl phenol ethoxylates, end-capped ethoxylates, ethoxylated alkanolamides, ethylene glycol esters, fatty acid alkanolamides, fatty alcohol alkoxylates, lauryl alcohol ethoxylates, monobranched alcohol ethoxylates, nonyl phenol ethoxylates, octyl phenol ethoxylates, random copolymer alkoxylates, sorbitan ester ethoxylates, stearic acid ethoxylates,
synthetic alcohol ethoxylates, tall oil fatty acid ethoxylates, tallow amine ethoxylates and mixtures thereof.

Preferably, said one or more anionic surfactants are selected from the group consisting of: alkyl ether phosphates, alkyl phenol ether phosphates, alkyl phenol ether sulfates, alkyl naphthalene sulfonates, condensed naphthalene sulfonates, aromatic hydrocarbon sulfonic acids, salts and blends, fatty alcohol sulfates, alkyl ether carboxylic acids and salts, alkyl ether sulfates, mono-alkyl sulfosuccinamates, di-alkyl sulfosuccinates, alkyl phosphates, alkyl benzene sulfonic acids and salts, alpha olefin sulfonates and mixtures thereof.

Preferably, said one or more amphoteric surfactants are selected from the group consisting of: alkyl amphoter(di)acetates, amido betaines, alkyl betaines and mixtures thereof.

Preferably, said one or more cationic surfactants are selected from the group consisting of: alkyl dimethylamines and alkyl amidopropylamines, quaternised amine ethoxylates, quaternary ammonium compounds and mixtures thereof.

Preferably, said one or more polymeric surfactants are selected from the group consisting of: comb-graft copolymer, condensed naphthalene sulfonates, polycarboxylates and mixtures thereof.

Preferably, said one or more stabilisers are selected from the group consisting of: silicone dioxide, magnesium aluminium silicate, montmorillonite clay, xanthan gum, heteropolysaccharide, glyceryl tri-12-hydroxystearate, hydroxy propyl methyl cellulose and mixtures thereof.

Preferably, said one or more corrosion inhibitors are selected from the group consisting of salts and/or esters of nitric acid and salts and/or esters of boric acid. More
preferably, said salts and/or esters of nitric acid and said salts and/or esters of boric acid are selected from the group consisting of: ammonium nitrate, potassium nitrate, sodium nitrate, ammonium borate and sodium borate. More preferably still, said salt of nitric acid is sodium nitrate. Preferably, said one or more antimicrobial agent is Zeomic.

According to a fifth aspect of the present invention there is provided an anti-spatter formulation, when prepared by a method according to the fourth aspect of the present invention.

In the preliminary work, which preceded the present invention, the inventors have identified a desirability for a relatively improved aqueous anti-spatter formulation, which has relatively low toxicity and is relatively effective in reducing the amount of welding spatter adhering to the metal surface that is being welded.

Surprisingly, the present inventors have found means to provide such a product, which is relatively low in toxicity and is relatively effective in reducing the amount of welding spatter from adhering to the metal surface that is being welded. Surprisingly, this has been achieved by using specific amounts of one or more or a combination of fats, oils, fatty acids, triglycerides in the anti-spatter product together with an aqueous carrier and depending on whether the formulation is a microemulsion or macroemulsion, one or more surfactants, and/or one or more stabilisers.

Further surprisingly, the inventive formulations are relatively cheap and convenient, as well as substantially non-toxic.

In addition, a gel that can act as a protective coating for the welding tip can be produced using the same formulations but increasing the relative amount of organic phase to the aqueous phase so that the aqueous phase is suspended in an organic carrier.
Fats, Oils, Fatty Acids, Triglycerides

One or more of a combination of fats, oils, fatty acids and/or triglycerides are included in the inventive compositions in an amount of about 0.001-99.999% w/v. Preferably, one or more of a combination of fats, oils, fatty acids or triglycerides are selected from the group consisting of C_4-C_24 fatty acids. Examples of such C_4-C_24 fatty acids include almond oil, beef tallow, butterfat (cow and/or goat), canola oil, cocoa butter, cod liver oil, coconut oil, corn oil, cottonseed oil, flaxseed oil, grape seed oil, lard (pork fat), olive oil, palm oil, palm olein, palm kernel oil, peanut oil, safflower oil, sesame oil, soybean oil, sunflower oil, walnut oil.

Surfactants

One or more surfactants are included in the composition of the invention in an amount of about 0-80% w/v. Suitable surfactants may be selected from the group consisting of non-ionic, anionic, cationic, polymeric or amphoteric surfactants.

Non-ionic surfactants can be selected from the group consisting of sorbitan fatty acid ester ethoxylates, sorbitan fatty acid esters Cs-C_{10} alkylphenol ethoxylates, C_9-Cn alcohol ethoxylates, C_8-C_{20} alkyl amine ethoxylates, castor oil ethoxylates, lanolin alcohol ethoxylates, or mixtures thereof.

Non-ionic surfactants can be selected from the group consisting of alkyl polysaccharides, alkylamine ethoxylates, amine oxides, block copolymers, castor oil ethoxylates, ceto-oleyl alcohol ethoxylates, ceto-stearyl alcohol ethoxylates, decyl alcohol ethoxylates, dinonyl phenol ethoxylates, dodecyl phenol ethoxylates, end-capped ethoxylates, ethoxylated alkanolamides, ethylene glycol esters, fatty acid alkanolamides, fatty alcohol alkoxylates, lauryl alcohol ethoxylates, mono-branched
alcohol ethoxylates, nonyl phenol ethoxylates, octyl phenol ethoxylates, random
copolymer alkoxylates, sorbitan ester ethoxylates, stearic acid ethoxylates, synthetic
alcohol ethoxylates, tall oil fatty acid ethoxylates, tallow amine ethoxylates, or mixtures
thereof.

Anionic surfactants can be selected from the group consisting of alkyl ether
phosphates, alkyl phenol ether phosphates, alkyl phenol ether sulfates, alkyl
naphthalene sulfonates, condensed naphthalene sulfonates, aromatic hydrocarbon
sulfonic acids, salts and blends, fatty alcohol sulfates, alkyl ether carboxylic acids and
salts, alkyl ether sulfates, mono-alkyl sulfo succinamates, di-alkyl sulfosuccinates, alkyl
phosphates, alkyl benzene sulfonic acids and salts, alpha olefin sulfonates, or mixtures
thereof.

Amphoteric surfactants can be selected from the group consisting of alkyl
ampho(di)acetates, amido betaines, alkyl betaines, or mixtures thereof.

Cationic surfactants can be selected from the group consisting of alkyl
dimethylamines and alkyl amidopropylamines, quaternised amine ethoxylates,
quaternary ammonium compounds, or mixtures thereof.

Polymeric surfactants can be selected from the group consisting of comb-graft
copolymer, condensed naphthalene sulfonates, polycarboxylates, or mixtures thereof.

Those skilled in the art will appreciate that not all of these surfactants can be
regarded as non-toxic. In the representative formulations given below, a surfactant of
relatively low toxicity is selected. However, the present invention is broad enough such
that other non-exemplified surfactants are within the scope of the invention.
Stabilisers

One or more stabilisers may be included in the composition of the present invention at a concentration of 0.001-10% w/v.

These stabilisers may be selected from the group consisting of, but not limited to, silicone dioxide, magnesium aluminium silicate, montmorillonite clay, xanthan gum, heteropolysaccharide, glyceryl tri-12-hydroxystearate, hydroxy propyl methyl cellulose, or mixtures thereof.

Corrosion Inhibitors

One or more corrosion inhibitors may be included in the composition of the present invention at a concentration of 0.001-5% w/v.

Non-exhaustive examples of suitable corrosion inhibitors are salts or esters of nitric acid selected from a group consisting of, but not limited to ammonium nitrate, potassium nitrate, and most preferably sodium nitrate; and salts or esters of boric acid such as ammonium borate and sodium borate.

Antimicrobial Agents

One or more antimicrobial agents may be included in the composition of the present invention at a concentration of 0.001-5% w/v to ensure biological stability. A non-exhaustive example of an antimicrobial agent is Zeomic.
Examples

*Examples of Anti-Spatter and Tip-Protective Gel Compositions:*

Listed below are examples of anti-spatter (Examples 1 and 2) and tip-protective (Examples 3 and 4) formulations.

**Example 1 — Anti-Spatter Product Formulation**

<table>
<thead>
<tr>
<th>Constituent Class</th>
<th>Chemical or Trade Name</th>
<th>Composition w/v %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous Carrier</td>
<td>Water</td>
<td>95.38</td>
</tr>
<tr>
<td>Organic Phase</td>
<td>Palm oil</td>
<td>4.00</td>
</tr>
<tr>
<td>Surfactant</td>
<td>Palm oil ethoxylate</td>
<td>0.50</td>
</tr>
<tr>
<td>Stabiliser</td>
<td>Xanthan gum</td>
<td>0.10</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>Sodium nitrate</td>
<td>0.01</td>
</tr>
<tr>
<td>Anti-Microbial Agent</td>
<td>Zeomic</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Example 2 — Anti-Spatter Product Formulation**

<table>
<thead>
<tr>
<th>Constituent Class</th>
<th>Chemical or Trade Name</th>
<th>Composition w/v %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous Carrier</td>
<td>Water</td>
<td>97.39</td>
</tr>
<tr>
<td>Organic Phase</td>
<td>Olive oil</td>
<td>2.00</td>
</tr>
<tr>
<td>Surfactant</td>
<td>Castor oil ethoxylate</td>
<td>0.50</td>
</tr>
<tr>
<td>Stabiliser</td>
<td>montmorillonite clay</td>
<td>0.10</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>Sodium borate</td>
<td>0.01</td>
</tr>
<tr>
<td>Anti-Microbial Agent</td>
<td>Zeomic</td>
<td>0.00</td>
</tr>
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</table>
Example 3 — Welding Tip Protector Product Formulation

<table>
<thead>
<tr>
<th>Constituent Class</th>
<th>Chemical or Trade Name</th>
<th>Composition w/v %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous Phase</td>
<td>Water</td>
<td>9.88</td>
</tr>
<tr>
<td>Organic Carrier</td>
<td>Palm oil</td>
<td>80.00</td>
</tr>
<tr>
<td>Surfactant</td>
<td>Palm oil ethoxylate</td>
<td>10.00</td>
</tr>
<tr>
<td>Stabiliser</td>
<td>Xanthan gum</td>
<td>0.10</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>Sodium nitrate</td>
<td>0.01</td>
</tr>
<tr>
<td>Anti-Microbial Agent</td>
<td>Zeomic</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Example 4 — Welding Tip Protector Product Formulation

<table>
<thead>
<tr>
<th>Constituent Class</th>
<th>Chemical or Trade Name</th>
<th>Composition w/v %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous Carrier</td>
<td>Water</td>
<td>14.88</td>
</tr>
<tr>
<td>Organic Phase</td>
<td>Olive oil</td>
<td>82.00</td>
</tr>
<tr>
<td>Surfactant</td>
<td>Castor oil ethoxylate</td>
<td>3.00</td>
</tr>
<tr>
<td>Stabiliser</td>
<td>montmorillonite clay</td>
<td>0.10</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>Sodium borate</td>
<td>0.01</td>
</tr>
<tr>
<td>Anti-Microbial Agent</td>
<td>Zeomic</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Although the invention has been described with reference to specific examples it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.
THE CLAIMS DEFINING THE INVENTION ARE AS Follows:-

1. An anti-spatter formulation comprising:

one or more fats, oils, fatty acids, and/or triglycerides;

an aqueous phase carrier; and

optionally, one or more surfactants, and/or one or more stabilisers,

said formulation thereby exhibiting relatively low toxicity and/or
relatively enhanced efficacy in reducing the amount of welding spatter
adhering to a welding instrument and/or a metal surface upon which
welding is effected.

2. An anti-spatter formulation according to claim 1, said formulation comprising:

0.001-99.999% w/v of said one or more fats, oils, fatty acids and/or
triglycerides;

0.001-99.999% w/v of said aqueous carrier phase;

0-80% w/v of said one or more surfactants; and

0-10% w/v of said one or more stabilisers.

3. An anti-spatter formulation according to claim 1 or claim 2, said formulation
comprising:

0.01-99.99% w/v of said one or more or a combination of fats, oils, fatty
acids and/or triglycerides;

0.01-99.99% w/v of said aqueous carrier phase;

0.01-80% w/v of said one or more surfactants;

0-80% w/v of one or more organic solvents;
0-5% w/v of one or more corrosion inhibitors; and
0-5% w/v of one or more antimicrobial agents;

4. An anti-spatter formulation according to any one of the preceding claims, said
   formulation further comprising 0.01-10% w/v of said one or more stabilisers.

5. An anti-spatter formulation according to any one of the preceding claims,
   wherein said aqueous carrier phase is water.

6. An anti-spatter formulation according to any one of the preceding claims,
   wherein said formulation is a microemulsion or a macroemulsion.

7. An anti-spatter formulation according to any one of the preceding claims,
   wherein said fats, oils, fatty acids and/or triglycerides comprise one or more
   C_{4}-C_{24} fatty acids.

8. An anti-spatter formulation according to claim 7, wherein said C_{4}-C_{24} fatty
   acids are selected from the group consisting of: almond oil, beef tallow,
   butterfat (cow and/or goat), canola oil, cocoa butter, cod liver oil, coconut oil,
   corn oil, cottonseed oil, flaxseed oil, grape seed oil, lard (pork fat), olive oil,
   palm oil, palm olein, palm kernel oil, peanut oil, safflower oil, sesame oil,
   soybean oil, sunflower oil and walnut oil.
9. An anti-spatter formulation according to any one of the preceding claims,
wherein said one or more surfactants are selected from the group consisting of:
non-ionic, anionic, cationic, polymeric and amphoteric surfactants.

10. An anti-spatter formulation according to claim 9, wherein said one or more
non-ionic surfactants are selected from the group consisting of: sorbitan fatty
acid ester ethoxylates, sorbitan fatty acid esters C₈-C₁₀ alkylphenol
ethoxylates, C₉-C₁₇ alcohol ethoxylates, C₈-C₂₀ alkyl amine ethoxylates, castor
oil ethoxylates, lanolin alcohol ethoxylates and mixtures thereof.

11. An anti-spatter formulation according to claim 9 or claim 10, wherein said one
or more non-ionic surfactants are selected from the group consisting of: alkyl
polysaccharides, alkylamine ethoxylates, amine oxides, block copolymers,
castor oil ethoxylates, ceto-oleyl alcohol ethoxylates, ceto-stearyl alcohol
ethoxylates, decyl alcohol ethoxylates, dinonyl phenol ethoxylates, dodecyl
phenol ethoxylates, end-capped ethoxylates, ethoxylated alkanolamides,
ethylene glycol esters, fatty acid alkanolamides, fatty alcohol alkoxylates,
lauryl alcohol ethoxylates, mono-branched alcohol ethoxylates, nonyl phenol
ethoxylates, octyl phenol ethoxylates, random copolymer alkoxylates, sorbitan
ester ethoxylates, stearic acid ethoxylates, synthetic alcohol ethoxylates, tall
oil fatty acid ethoxylates, tallow amine ethoxylates and mixtures thereof.

12. An anti-spatter formulation according to any one of the preceding claims,
wherein said one or more anionic surfactants are selected from the group consisting of: alkyl ether phosphates, alkyl phenol ether phosphates, alkyl phenol ether sulfates, alkyl naphthalene sulfonates, condensed naphthalene sulfonates, aromatic hydrocarbon sulfonic acids, salts and blends, fatty alcohol sulfates, alkyl ether carboxylic acids and salts, alkyl ether sulfates, mono-alkyl sulfosuccinamates, di-alkyl sulfosuccinates, alkyl phosphates, alkyl benzene sulfonic acids and salts, alpha olefin sulfonates and mixtures thereof.

13. An anti-spatter formulation according to any one of the preceding claims, wherein said one or more amphoteric surfactants are selected from the group consisting of: alkyl amphot(di)acetates, amido betaines, alkyl betaines and mixtures thereof.

14. An anti-spatter formulation according to any one of the preceding claims, wherein said one or more cationic surfactants are selected from the group consisting of: alkyl dimethylamines and alkyl amidopropylamines, quaternised amine ethoxylates, quaternary ammonium compounds and mixtures thereof.

15. An anti-spatter formulation according to any one of the preceding claims, wherein said one or more polymeric surfactants are selected from the group consisting of: comb-graft copolymer, condensed naphthalene sulfonates, polycarboxylates and mixtures thereof.
16. An anti-spatter formulation according to any one of the preceding claims, wherein said one or more stabilisers are selected from the group consisting of: silicone dioxide, magnesium aluminium silicate, montmorillonite clay, xanthan gum, heteropoly saccharide, glyceryl tri-12-hydroxystearate, hydroxy propyl methyl cellulose and mixtures thereof.

17. An anti-spatter formulation according to any one of the preceding claims, wherein said one or more corrosion inhibitors are selected from the group consisting of: salts and/or esters of nitric acid and salts and/or esters of boric acid.

18. An anti-spatter formulation according to claim 17, wherein said salts and/or esters of nitric acid and salts and/or esters of boric acid are selected from the group consisting of: ammonium nitrate, potassium nitrate, sodium nitrate, ammonium borate and sodium borate.

19. An anti-spatter formulation according to claim 17 or claim 18, wherein said salt of nitric acid is sodium nitrate.

20. An anti-spatter formulation according to any one of the preceding claims, wherein said antimicrobial agent is Zeomic.

21. An anti-spatter formulation according to any one of the preceding claims, wherein said aqueous carrier phase is present in an amount of about 10% w/v;
said organic carrier phase is present in an amount of about 80% w/v; and said one or more surfactants are present in an amount of about 10% w/v.

22. An anti-spatter formulation according to any one of the preceding claims, said composition comprising the following approximate proportions: water 95.38, palm oil 4.00, palm oil ethoxylate 0.50, xanthan gum 0.10, sodium nitrate 0.01, zeomic 0.01% w/v.

23. An anti-spatter formulation according to any one of claims 1 to 21, said composition comprising the following approximate proportions: water 97.39, olive oil 2.00, castor oil ethoxylate 0.50, montmorillonite clay 0.10, sodium borate 0.01% w/v.

24. An anti-spatter formulation according to any one of the preceding claims, wherein the relative amount of said organic phase is increased relative to the amount of said aqueous carrier phase.

25. An anti-spatter formulation according to any one of the preceding claims, wherein said aqueous carrier phase is suspended in said organic carrier phase, with the relative amounts thereof selected such that said formulation is a gel for acting as a protective coating for the tip of said welding instrument.

26. An anti-spatter formulation according to claim 24 or claim 25, wherein said aqueous carrier phase is present in an amount of about 95% w/v and said organic carrier phase is present in an amount of about 4% w/v.
27. An anti-spatter formulation according to any one of claims 24 to 26, wherein said composition is a welding tip protector formulation comprising the following approximate proportions: water 9.88, palm oil 80.00, palm oil ethoxylate 10.00, xanthan gum 0.10, sodium nitrate 0.01, zeomic 0.01% w/v.

28. An anti-spatter formulation according to any one of claims 24 to 26, wherein said composition is a welding tip protector formulation comprising the following approximate proportions: water 14.88, olive oil 82.00, castor oil ethoxylate 3.00, montmorillonite clay 0.10, sodium borate 0.01, zeomic 0.01% w/v.

29. A method of applying an effective amount of an anti-spatter formulation according to any one of the preceding claims to a metal surface, said method comprising:
   spraying, dip coating, flow coating, or a combination thereof.

30. A method for preventing or substantially reducing spatter in welding, said method comprising applying a formulation according to any one of claims 1 to 28 to a welding apparatus and/or a surface to be welded.

31. A method of preparing an anti-spatter formulation, said method comprising the steps of:
III. preparing an organic carrier phase solution comprising one or more
or a combination of fats, oils, fatty acids or triglycerides; and

IV. adding an aqueous carrier phase to said organic carrier phase.

32. A method according to claim 31, wherein said organic carrier phase is within
the temperature range 15-80 °C.

33. A method according to claim 31 or claim 32, wherein said organic carrier
phase is within the temperature range 40-60 °C.

34. A method according to any one of claims 31 to 33, wherein said aqueous
carrier phase is within the temperature range 15-80 °C.

35. A method according to any one of claims 31 to 34, wherein said aqueous
carrier phase is within the temperature range 40-60 °C.

36. A method according to any one of claims 31 to 35, wherein one or more
surfactants are added to said organic carrier phase and/or said aqueous carrier
phase prior to step II.

37. A method according to any one of claims 31 to 36, wherein one or more
solvents are added to said organic carrier phase and/or said aqueous carrier
phase prior to step II.
38. A method according to any one of claims 31 to 37, wherein said formulation is a microemulsion or a macroemulsion.

39. A method according to claim 38, wherein said aqueous carrier phase is added to said organic carrier phase in incremental portions until the desired said microemulsion or said macroemulsion has been formed.

40. A method according to claim 39, wherein once said macroemulsion is formed, said one or more stabilisers are added whilst said macroemulsion is being homogenised.

41. A method according to claim 39, wherein once said macroemulsion is formed, said one or more stabilisers are added once said macroemulsion is homogenised.

42. A method according to any one of claims 31 to 41, wherein one or more antimicrobial agents and/or one or more corrosion inhibitors are added to said aqueous carrier phase and/or said organic carrier phase.

43. A method according to any one of claims 31 to 42, wherein one or more antimicrobial agents and/or one or more corrosion inhibitors are added to said microemulsion or said macroemulsion once formed.
44. A method according to any one of claims 31 to 43, wherein said fats, oils, fatty acids and/or triglycerides comprise one or more C₄-C₂₄ fatty acids.

45. A method according to claim 44, wherein said one or more C₄-C₂₄ fatty acids are selected from the group consisting of: almond oil, beef tallow, butterfat (cow and/or goat), canola oil, cocoa butter, cod liver oil, coconut oil, corn oil, cottonseed oil, flaxseed oil, grape seed oil, lard (pork fat), olive oil, palm oil, palm olein, palm kernel oil, peanut oil, safflower oil, sesame oil, soybean oil, sunflower oil and walnut oil.

46. A method according to any one of claims 31 to 45, wherein said one or more surfactants are selected from the group consisting of: non-ionic, anionic, cationic, polymeric and amphoteric surfactants.

47. A method according to claim 46, wherein said one or more non-ionic surfactants are selected from the group consisting of: sorbitan fatty acid ester ethoxylates, sorbitan fatty acid esters C₈-C₁₀ alkylphenol ethoxylates, C₉-C₁₇ alcohol ethoxylates, C₈-C₂₀ alkyl amine ethoxylates, castor oil ethoxylates, lanolin alcohol ethoxylates and mixtures thereof.

48. A method according to claim 46 or claim 47, wherein said one or more non-ionic surfactants are selected from the group consisting of: alkyl polysaccharides, alkylamine ethoxylates, amine oxides, block copolymers, castor oil ethoxylates, ceto-oleyl alcohol ethoxylates, ceto-stearyl alcohol
ethoxylates, decyl alcohol ethoxylates, dinonyl phenol ethoxylates, dodecyl phenol ethoxylates, end-capped ethoxylates, ethoxylated alkanolamides, ethylene glycol esters, fatty acid alkanolamides, fatty alcohol alkoxylates, lauryl alcohol ethoxylates, mono-branched alcohol ethoxylates, nonyl phenol ethoxylates, octyl phenol ethoxylates, random copolymer alkoxylates, sorbitan ester ethoxylates, stearic acid ethoxylates, synthetic alcohol ethoxylates, tall oil fatty acid ethoxylates, tallow amine ethoxylates and mixtures thereof.

49. A method according to any one of claims 31 to 48, wherein said one or more anionic surfactants are selected from the group consisting of: alkyl ether phosphates, alkyl phenol ether phosphates, alkyl phenol ether sulfates, alkyl naphthalene sulfonates, condensed naphthalene sulfonates, aromatic hydrocarbon sulfonic acids, salts and blends, fatty alcohol sulfates, alkyl ether carboxylic acids and salts, alkyl ether sulfates, mono-alkyl sulfosuccinamates, di-alkyl sulfosuccinates, alkyl phosphates, alkyl benzene sulfonic acids and salts, alpha olefin sulfonates and mixtures thereof.

50. A method according to any one of claims 31 to 49, wherein said one or more amphoteric surfactants are selected from the group consisting of: alkyl ampho(di)acetates, amido betaines, alkyl betaines and mixtures thereof.

51. A method according to any one of claims 31 to 50, wherein said one or more cationic surfactants are selected from the group consisting of: alkyl
dimethylamines and alkyl amidopropylamines, quaternised amine ethoxylates, quaternary ammonium compounds and mixtures thereof.

52. A method according to any one of claims 31 to 51, wherein said one or more polymeric surfactants are selected from the group consisting of: comb-graft copolymer, condensed naphthalene sulfonates, polycarboxylates and mixtures thereof.

53. A method according to any one of claims 31 to 52, wherein said one or more stabilisers are selected from the group consisting of: silicone dioxide, magnesium aluminium silicate, montmorillonite clay, xanthan gum, heteropolysaccharide, glyceryl tri-12-hydroxystearate, hydroxy propyl methyl cellulose and mixtures thereof.

54. A method according to any one of claims 31 to 53, wherein said one or more corrosion inhibitors are selected from the group consisting of salts and/or esters of nitric acid and salts and/or esters of boric acid.

55. A method according to claim 54, wherein said salts and/or esters of nitric acid and said salts and/or esters of boric acid are selected from the group consisting of: ammonium nitrate, potassium nitrate, sodium nitrate, ammonium borate and sodium borate.
56. A method according to claim 54 or claim 55, wherein said salt of nitric acid is sodium nitrate.

57. A method according to any one of claims 31 to 56, wherein said one or more antimicrobial agent is Zeomic.

58. An anti-spatter formulation, when prepared by a method according to any one of claims 31 to 57.

59. An anti-spatter formulation substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

60. A method of applying an effective amount of an anti-spatter formulation substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

61. A method for preventing or substantially reducing spatter in welding, substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

62. A method of preparing an anti-spatter formulation substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.
63. An anti-spatter formulation, when prepared by a method substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.
INTERNATIONAL SEARCH REPORT

International application No. PCT/AU2006/001797

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
B23K 35/36(2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

DWPI, JAPIO, Espace, and keywords: weld+, B23K, spatter+, splutter, fat?, oil?, fatty acid?, triglycerides, aqueous, liquid, fluid, water, carrier, emulsion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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Further documents are listed in the continuation of Box C

* Special categories of cited documents:
  
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Date of the actual completion of the international search 12 February 2007

Date of mailing of the international search report WIE13 2007

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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