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### (54) Anti-misting additive for hydrocarbon fluids.

(57) Hydrocarbon liquids such as fuels for gas turbine engines and metal cutting fluids are inhibited to the formation of dispersions upon application of shock or stress thereto by an effective amount to prevent such dispersion formation of a high molecular weight addition polymer of 1,2-epoxybutane.

ACTORUM AG

# ANTI-MISTING ADDITIVE
# FOR HYDROCARBON FLUIDS

The invention relates to a process for preventing the dissemination of a hydrocarbon liquid having a free surface into a dispersion of fine liquid droplets under conditions of shock or stress. It is often desirable to control the extent of misting or dispersion-in-air of hydrocarbon liquids having rather low flash points. More particularly, hydrocarbon fuels such as are employed in aircraft are desirably protected from misting under conditions of shock or stress as produced, for example, during an aircraft crash, or whenever such fuels are subjected to shock or stress while exposed to an ignition source. Additionally it is also desirable to control mist formation in hydrocarbon-based metal cutting fluids employed in metal cutting, grinding and machining operations.

In U.S. Patent 3,996,023, several polymers suitably employed in preventing the misting of hydrocarbon fuels are disclosed. Preferred compounds include non-crystalline polymers substantially devoid of polar groups, especially polymers of ethylenically unsaturated hydrocarbons such as ethylene, propylene, isobutylene, and butadiene. Polymers formed by the addition polymerization of alkylene oxides are briefly discussed. In U.S. Patent 3,557,017, ultra high molecular weight oxyalkylene polymers are taught as demulsifiers and thickeners for hydrocarbon systems used in oil well fracturing. Preferred oxyalkylene oxide polymers were those derived from propylene oxide.

Numerous catalyst systems are known for preparation of high molecular weight alkylene oxides. Illustrative are a combination of ferric halide salts and propylene oxide disclosed in U.S. Patent 2,706,181, or organoaluminum, organozinc and organomagnesium compounds taught in U.S. Patent 2,870,100. Improved coordination anionic polymerization systems include chelated forms of organoaluminum such as disclosed in U.S.Patents 3,219,591; 3,186,958; 3,301,796; and 3,135,705.

In recent investigations the important contribution of elongation deformation to polymeric rheological behavior has been identified. It has now been recognized that various properties of significant commercial application cannot be adequately predicted by viscometric (shear) flow behavior alone. Often, due to inherent differences in elongation or tensile deformation versus shear deformation, the corresponding elongational viscosity and shear viscosity may be related in only the extremely limited case where the material is Newtonian in both elongation and shear. Because of this recognized difference between elongational and shear flow, the researcher is not necessarily able to predict the response to elongational flow of a viscoelastic material based on knowledge of its shear flow behavior. Such elongational deformation properties are in fact particularly relevant in imparting improved performance to anti-misting agents. Because the tensile or elongational viscosity of various materials appears to be affected by molecular weight considerations, particularly the average molecular weight and the distribution thereof, as well as by molecular geometry, the elongation properties of polymeric compounds and therefore the anti-misting properties thereof are not necessarily predictable on the basis of shear viscosity considerations.

Another important property of an anti-misting agent is the shear stability of the material. Application of relatively mild shear should not significantly degrade the polymer and thereby destroy the polymer's ability to prevent the dispersion of the hydrocarbon liquid. For example, normal pumping and handling procedures used in transporting a jet fuel should not cause deterioration of the anti-misting properties of the polymer. Shear stability is particularly desired in cutting fluids due to repeated use under conditions of relatively high shear.

It would be desirable to provide a polymer that is effective in preventing the formation of hydrocarbon-air dispersions or mists at low levels of concentration, that is highly soluble in the hydrocarbon liquid, such that even at extremely low temperatures essentially no precipitate or colloidal state forms, and that is relatively stable and not degraded by shear forces.

Accordingly, there is now provided an improved process for preventing the dispersion of a hydrocarbon liquid having a free surface upon application of shock or stress comprising adding to the hydrocarbon liquid an effective amount to prevent the dispersion thereof of a high molecular weight addition polymer comprising polymerized 1,2-epoxybutane. Also provided is a composition comprising a hydrocarbon liquid and an effective amount to prevent the formation of a dispersion thereof upon application of shock or stress thereto of a high molecular weight addition polymer comprising polymerized 1,2-epoxybutane.

Addition polymers comprising polybutylene oxide, e.g., addition polymers of 1,2-epoxybutane, useful herein may be prepared by any technique suited to the preparation of extremely high molecular weight polymers. Examples include the anionic polymerization of U.S. Patents, 2,870,100 and 3,219,591.

A preferred catalyst for polymerizing 1,2-epoxybutane to extremely high molecular weight polybutylene oxide comprises a composition prepared by contacting:

Component A, a compound represented by the formula RR'AlX wherein R and R' each independently represent an alkyl group of 1 to 4 carbon atoms, and X represents hydrogen or an alkyl or alkoxy group of 1 to 4 carbon atoms;

Component B, an organic nitrogen base compound selected from secondary nitrogen-containing compounds having basicity about equal to or less than the basicity of dimethylamine and having no active hydrogen atoms other than those of the secondary nitrogen;

Component C, a β-diketone; and
Component D, water;

in the molar ratios of

B:A - 0.01:1 to 2.5:1
C:A - 0.1:1 to 1.5:1
D:A - 0.01:1 to 1.5:1

provided that when the molar ratio of (C + 2D):A is greater than 3:1, the B:A molar ratio is at least 1:1.

The preferred catalyst is more particularly defined as follows. Component A is a compound represented by the formula RR'AlX wherein R and R' each independently represent an alkyl group of 1 to 4 carbon atoms, and X represents hydrogen or an alkyl or alkoxy group of 1 to 4 carbon atoms. In a preferred mode, X represents an alkyl group. In a more preferred mode, R, R' and X all represent the same alkyl group and most preferably, the compound is triethylaluminum. Examples of suitable compounds are trimethylaluminum, triethylaluminum, triisobutylaluminum, tri-n-propylaluminum, tri-n-butylaluminum, diethylaluminum hydride, dipropylaluminum hydride, diisobutylaluminum hydride, diethyl ethoxy aluminum, and diisobutyl ethoxy aluminum. In practice, Component A is normally supplied in a solution of a hydrocarbon or other solvent.

Component B is an organic nitrogen base compound selected from secondary nitrogen-containing compounds having basicity about equal to or less than the basicity of dimethylamine and having no active hydrogen atoms other than those of the secondary nitrogen. By "active hydrogen atoms" are meant Zerewitinoff hydrogen atoms (see J. Am. Chem. Soc., 49:3181 (1928)) which initiate alkylene oxide polymerization as are found on hydroxyl, thio or primary and secondary amine functional groups. Such secondary amines are commonly those bearing electron-withdrawing groups in close proximity to the nitrogen atom such as carbonyl groups, phenyl rings, cyano groups, halo groups, carboxylic acids or ester groups, and other such groups that have strong electron-withdrawing effects on the secondary amine. For example, such compounds are N-alkyl or -aryl amides, arylalkylamines, diarylamines, and other weak bases. Secondary amines having a $pK_b$ of greater than 4 are suitable and those having $pK_b$ of greater than 6 are preferred. Examples of suitable secondary amines are dimethylamine, diethylamine, N-methylaniline, N-methyl-p-nitroaniline, N-alkylacetamide, N-arylacetamide, succinimide, diphenylamine, phenothiazines, and phenoxazines. Especially preferred are phenoxazine, phenothiazine and N-acetamide.

The strengths of organic bases are compiled for a large number of such bases in the IUPAC work by D. D. Perrin, "Dissociation Constants of Organic Bases in Aqueous Solutions", Butterworths (London, 1965). For most secondary organic amines not listed therein, relative base strength may be deduced by examining the value noted for a structurally related amine then estimating the effect of structural differences on the base strength. For example, conjugation of the amino group with electron-withdrawing groups lowers the base strength of the amino group. The effects of structural changes in organic amines are discussed in great detail in numerous works, for example in "The Chemistry of the

Amino Group", S. Patai, Ed., Chapter 4, "Basicity and Complex Formation" by J. W. Smith, pp. 161-204, Interscience (New York, 1968).

One simple method for determining whether a secondary amine is less basic than dimethylamine is to employ both in side-by-side preparation of the catalyst, use the resulting catalyst in polymerization of a monomer such as propylene oxide, and then determine the intrinsic viscosities of the resulting polypropylene oxide products. If the intrinsic viscosity of the product derived from the catalyst prepared with dimethylamine is lower than the one from the other amine, then the other amine may be considered less basic than dimethylamine.

The amount of Component B to be employed may be expressed in the molar ratio of Component B per mole of Component A. The lower amount is suitably about 0.01, preferably 0.05 and most preferably 0.1. The upper amount is suitably 2.5, preferably 1 and most preferably 0.5. The optimum molar ratio of B:A for producing very high molecular weight polyethers is about 0.25:1.

Component C is selected from β-diketones or the tautomeric enol form thereof. Suitable, for example, are 2,4-pentanedione, 2,4-hexanedione, 3,5-heptanedione, 1-phenyl-1,3-butanedione, ethylacetylacetate, and similar materials. Examples of numerous suitable β-diketones are described in U.S. Patent 2,866,761. Preferred for use as Component C is 2,4-pentanedione because of its relative availability.

For the amount of Component C to be employed, expressed as moles of C per mole of A, a lower amount is suitably 0.1 and preferably 0.2. As an upper amount the ratio is suitably 1.5 and preferably 0.8. The optimum molar ratio of C:A is about 0.5:1.

Component D is water and is suitably employed in a lower amount of about 0.1, preferably 0.3 and more preferably 0.4, mole of D per mole of A. The upper amount is suitably 1.5, preferably 1.1 and more preferably 1.0, mole of D per mole of A. The optimum ratio of D:A is 0.5 to 0.8:1.

The above components are employed such that when the molar ratio sum of (C + 2D):A is greater than 3:1, then the B:A molar ratio is at least 1:1. Preferably the components are combined in the ratio where (B + C + 2D):A is less than or equal to 3:1 and more preferably less than 2:1. In one embodiment, the following molar ratios are employed to form a catalyst which when contacted with a vicinal alkylene oxide produces a polyether of a very high intrinsic viscosity: B:A - about 0.25:1; C:A - about 0.5:1; and D:A - about 0.6:1. In a second embodiment, a catalyst is prepared which will give moderately high intrinsic viscosity polyethers when contacted with vicinal alkylene oxides according to the process described herein. The molar ratios in this second embodiment are: B:A - about 2.5:1; C:A -about 0.5:1; and D:A - about 0.5:1. The most preferred species of the catalyst are prepared in the form where B is phenothiazine or N-methylacetamide or C is 2,4-pentanedione.

Additional components may be present in the catalyst and certain additives have in fact been found to provide improved catalytic performance. In particular, a small but effective amount of a Lewis base such as a tertiary amine or an aliphatic ether capable of forming a complex with Component A may be added to the catalyst mixture. Preferred Lewis base compounds are the aliphatic ethers, most suitably cyclic aliphatic ethers such as tetrahydrofuran or dioxane. These compounds are employed in minor amounts sufficient to form a complex with Component A in the presence of the remaining components of the catalyst. Suitably the aliphatic ether is present in molar amounts from 1 to 6 for each mole of Component A.

Additional components may also be present in the catalyst if desired. For example, ether alcohols such as 2-methoxyethanol, 2-ethoxyethanol, 2-butoxyethanol, 2-methoxypropanol, 2-ethoxypropanol, and lower alkyl monoethers of diethylene glycol or dipropylene glycol may be added to the catalyst in purified form as an aid in rendering the catalyst soluble in various solvents.

The catalyst formation and polymerization are carried out according to known techniques such as those of U.S. Patents 3,186,958 and 3,219,591. Suitably the catalyst is prepared by contacting the components in the desired ratios in any of the common hydrocarbon or chlorinated hydrocarbon diluents employed for organic reactions so long as they do not bear Zerewitinoff hydrogen atoms. Suitable diluents, for example, are hexane, toluene, benzene, styrene, decane, chlorobenzene, trichloroethane, perchloroethylene and the like. A preferred diluent is the hydrocarbon fluid, e.g., fuel or cutting oil, to which the polymer will be later added.

While the catalyst components may be combined in any order desired, because it has been found most effective to employ polymers of relatively high intrinsic viscosity in the present invention, it is preferable, particularly where the catalyst consists essentially of only Components A, B, C and D, that Components B, C and D be first combined by mixing them well and thereafter adding Component A to the mixture of the other three components. It is also convenient to prepare the catalyst in situ in the butylene oxide monomer to be polymerized. This is most preferably done by combining Components B, C and D in a solvent with the desired quantity of butylene oxide monomer and thereafter adding Component A to the mixture after which the polymerization is allowed to proceed. In this fashion, the butylene oxide monomer acts as a cosolvent for the catalyst prior to initiation of the polymerization. Butylene oxide for polymerization and use herein may first be purified as by the technique described in U.S. Patent 3,987,065.

After preparation of the high molecular weight polymer, the catalyst may be "killed" or deactivated by addition of a reactive hydroxyl compound such as water, alcohols or organic acids. Where the polymer is prepared in the hydrocarbon fluid, such as jet fuel, the catalyst may be effectively "killed" by exposure to the atmosphere for a short time. It is believed that water vapor present in the air is sufficient to deactivate the catalyst.

The polymer employed in the instant process comprises polybutylene oxide. Where the hydrocarbon liquid is a fuel, for example, a jet fuel for gas turbines, it is highly desirable that the polymeric anti-misting additive not detrimentally form a precipitate or colloidal state, particularly at low temperatures. The temperature at which such formation occurs, e.g., the theta temperature of the solution, is desirably less than -50°C. Further discussion of theta temperature as well as a more detailed description of suitable components of fuels for gas turbines is contained in U.S. Patent 3,996,023.

In other applications such as where the hydrocarbon liquid is a cutting fluid, extremely low theta temperatures are not as necessary. Accordingly, a theta temperature of greater than -50°C may be suitable. At the same time certain hydrocarbon liquids, especially cutting fluids, may contain substantial amounts of a non-hydrocarbon component, such as an alkylene glycol, an alkylene glycol ether or even water. Therefore under conditions where an extremely low theta temperature is not requisite or the hydrocarbon liquid additionally comprises non-hydrocarbon components, the polybutylene oxide anti-misting agent may include comonomers of additional alkylene oxides. Compatibility with fluids consisting essentially of hydrocarbon liquids is impaired by use of excessive amounts of lower alkylene oxide comonomers such as propylene oxide and especially ethylene oxide. Accordingly, only relatively minor amounts of such lower alkylene oxide comonomers are suitably employed where compatibility with hydrocarbon liquids, particularly a jet fuel, is desired. Higher vicinal alkylene oxides such as 1,2-epoxypentane, 1,2-epoxyhexane, etc., or glycidyl ethers such as n-butyl glycidyl ether, tertiarybutyl glycidyl ether, n-octyl glycidyl ether, etc., may be employed as comonomers without as significant a detrimental effect on compatibility with the hydrocarbon fluid.

The preferred anti-misting agent for use in hydrocarbon fuels consists essentially of polymerized 1,2-epoxybutane.

While in most applications the catalyst residue may be left in the polymer solution without disadvantageous results, it is also possible to remove catalyst residue. For example, the aluminum compound which exists as a hydroxide or oxide after deactivation is only sparingly soluble in hydrocarbon liquids, particularly at low temperatures and may be removed by filtration. This process may be particularly desired where the polymer solution is employed as a jet fuel.

Conventional approaches to molecular weight measure of polyethers employed herein are often not appropriate. This is usually due to plugging effects because of the propensity of high molecular weight polyethers to "thicken with shear". It is especially troublesome with such techniques as gel permeation chromatography for molecular weight estimation. Nonetheless, dissolved concentrations of less than 0.06 weight percent of the polyethers generally do not undergo the shear thickening phenomenon.

In view of the difficulties in employing gel permeation chromatography to compare the relative molecular weights of polyethers produced herein, the alternate method of comparing intrinsic viscosities was instead employed. Intrinsic viscosity $[\eta]$ is related to molecular weight by the equation:

$$[\eta] = MK^{\alpha}$$

wherein K is a constant, M is molecular weight and $\alpha$ is another constant (correlated to the degree of configurational coiling in the architecture of an involved polymer).

The value of $[\eta]$ is determined by plotting the measured specific viscosity divided by concentration of polymer in solution ($\eta_{sp}$/conc.) vs. conc. and extrapolating to zero concentration. It is dependent upon the solvent and temperature used during measurements. Toluene is a good solvent for the purpose. And, 100°F (38°C) is an apt temperature at which to measure $\eta_{sp}$, per the equation:

$$\eta_{sp} = \frac{t-t_o}{t_o} \quad ,$$

wherein t is the efflux time of solution and $t_o$ is the efflux time of solvent.

Efflux times are readily measurable in an Ostwald viscometer taking values of solutions at four different concentrations. Usually 1-2 g of the polymer solution (≅30 percent solids) is dissolved in toluene overnight with stirring. It is then volumetrically diluted to ≅100 ml. Aliquots of 2 ml, 5 ml, and 15 ml from this stock solution are then further diluted to: 10 ml, 10 ml, and 25 ml, respectively, with more toluene. Efflux times are then measured on the stock solution, each of the three solutions and on toluene. With the viscometer employed, toluene had a $t_o$ of 30.6 seconds, while t for the most concentrated solution being tested is best kept below 200 seconds by adjusting concentration.

Concentration for each diluted solution is simply calculable from the concentration of the stock solution. Three samples of this stock solution are then ordinarily weighed into aluminum dishes from which they are devolatilized in a vacuum oven at 100°C overnight (under a normal line vacuum). The aluminum dishes are then reweighed to determine the weight of pure polymer remaining. Concentration is then calculated as weight percent. This method of determining concentration is quite convenient since concentration normally associated with measuring $[\eta]$ is reported in the literature as "grams/deciliter". Therefore, values for concentration so determined are higher by a factor corresponding to the density of toluene (0.8502 g/cc at 38°C). Values for $\eta_{sp}$/conc. and $[\eta]$ are correspondingly, therefore, lower by this factor also. Consistent with this, the herein given $[\eta]$ values are corrected for the density factor, with $[\eta]$ being herein reported in units of dl/g.

Of particular value in the present invention as anti-misting agents in hydrocarbon fuels are polymerized 1,2-epoxybutanes having relatively high intrinsic viscosity, e.g., intrinsic viscosities in toluene at 38°C of at least and preferably 2 and up to 30. Because of the greater effectiveness toward preventing misting of higher molecular weight polybutylene oxide polymers, such polymers of higher molecular weight may be employed in reduced concentrations thereby resulting in more economical operation. Preferred are concentrations by weight from 0.05 percent to 1 percent, and preferably from 0.1 percent to 0.5 percent by weight.

In other applications, such as the prevention of cutting oil misting, polybutylene oxide polymers of reduced molecular weight and therefore intrinsic viscosity may be more suitably employed in order to avoid the necessary reduction in polymer effectiveness due to shear degradation of the polymer under long-life service conditions. At the same time, increased levels of polymer may be employed in order to offset the loss in effectiveness due to decreased molecular chain length. Preferred for use in cutting fluids are amounts of polymer by weight from 0.1 percent to 5.0 percent, most preferably from 0.2 percent to 1.0 percent.

In particular regard to hydrocarbon fuels, it should be noted that while the extremely high molecular weight butylene oxide polymers herein employed are highly shear stable, they will in fact degrade under application of sufficiently high shear. Accordingly, it is possible, employing mechanical shearing or other treatment, to degrade the polymer and thereby render the fuel atomizable or dispersible prior to injection into the gas turbine.

The following examples are provided as further illustrations of the invention.

Example 1 - Cutting Oil

Twenty-five grams of 1,2-butylene oxide, Mobilmet 308® metal cutting and working oil available commercially from Mobil Oil Corporation (225 g), phenothiazine (1.17 g) and 2,4-pentanedione (1.18 g) are combined in a glass reactor. A sample is removed for water analysis and found to contain 86 ppm water. Additional water (0.19 g) is added by syringe to produce a total water content of 0.21 g, triethylaluminum (14.8 percent in hexane) (18.0 g) is added under a nitrogen blanket. The reactor is sealed and placed in a tumbling cage inside a warm water bath at about 86°C for 44 hours.

After polymerization, cutting oil containing polymerized 1,2-butylene oxide is tested for mist formation. A solution of Mobilmet 308® cutting oil containing 0.25 percent by weight of the above polymer is prepared by rapidly stirring a portion of the above product in the cutting oil. Viscosity of the solution as determined by the cone-plate method is 0.055 Pa·S (55 cps). Unmodified oil has a viscosity of 0.051 Pa·S (51 cps).

Mist control is tested by comparing mist formation upon injecting air (0.38 MPa; 40 psig) through a drop tube immersed in the fluid to be tested. Mist formation is noted by visual reference and assigned values of no-mist, low-mist or fail. The fluid is then exposed to high shear in a laboratory blender for one hour and retested for anti-mist properties. The cutting oil containing 0.25 weight percent polybutylene oxide showed no mist formation even after blending for one hour. Untreated Mobilmet 308® produced large amounts of mist under all testing conditions.

<u>Example 2</u> - Jet Fuel

An additional quantity of polymerized 1,2-butylene oxide is prepared in hexane solvent. The catalyst employed is prepared by combining in a dry box under nitrogen atmosphere at ambient temperature with stirring, hexane solutions of triisobutylaluminum (0.015 mole) and phenothiazine (0.004 mole) (total hexane is about 40 ml). Tetrahydrofuran (0.090 mole) is added dropwise with stirring over a period of about 10 minutes at reduced temperature of 0°C-10°C. Next, water (enough to provide 0.006 mole total) is added dropwise over a period of 10 minutes, followed by acetylacetone (0.006 mole) which is added dropwise over a period of 5 minutes. The reaction mixture is stirred for 1 hour and transferred to a Parr bomb reactor and diluted with hexane (100 g) and toluene (30 g). After aging by heating and stirring under nitrogen for one hour at 95°C, catalyst preparation is complete.

The polymer is formed by adding about one mole of 1,2-butylene oxide to the Paar bomb in increments at 75°C over a one-hour period. The reaction mixture is stirred at 75°C for 5 hours and then cooled. Evaporation of solvent leaves the desired polymer, a light amber colored rubbery solid.

Jet fuel (Jet A) containing 0.2 percent by weight of polymerized 1,2-butylene oxide prepared employing the catalyst prepared according to the above process is tested for anti-misting properties by means of the Flammability Comparison Test Apparatus (FCTA). The testing device consists of a compressed air source connected to a sonic orifice and a diffuser cone. Fuel is supplied through a metal tube terminating in the airstream at a point selected to produce high shear to the fuel entering the airstream. The air fuel mist thereby prepared is passed over a propane torch flame.

Mist ignition is determined by fuel type (including the presence or absence of an anti-misting agent), the fuel flow rate and the air velocity.

Passing, marginal and fail grades are assigned according to visual examination of the flame propagation. No propagation ahead of the torch constitutes a passing grade. Propagation ahead of the torch but not to the diffuser cone constitutes a marginal grade. Propagation ahead of the torch all the way to the diffuser cone constitutes a failing grade.

Jet A fuel at 27°C which is not treated with an anti-misting agent consistently fails under all conditions of air velocity above 40 m/sec at fuel flow rates above 10 ml/sec. To the contrary, when modified by addition of 0.2 weight percent of polymerized 1,2-butylene oxide, no consistent failure is observed at fuel flow rates less than 16 ml/sec at air velocities less than 70 m/sec.

The above test demonstrates that polymerized 1,2-butylene oxide is an effective anti-misting agent which demonstrates surprisingly good effectiveness at preventing the formation of a hydrocarbon fuel/air dispersion even at extremely low concentrations.

1. A process for preventing the dispersion of a hydrocarbon liquid having a free surface upon application of shock or stress comprising adding to the hydrocarbon liquid an effective amount to prevent the dispersion thereof of a high molecular weight addition polymer comprising polymerized 1,2-epoxybutane.

2. A process according to Claim 1 wherein the hydrocarbon liquid is a hydrocarbon fuel suitable for use in a gas turbine engine.

3. A process according to Claim 2 wherein the addition polymer has a specific viscosity measured in toluene at 38°C of at least 1.

4. A process according to Claim 3 wherein the addition polymer has a specific viscosity measured in toluene at 38°C of at least 2.

5. A process according to Claim 2 wherein the high molecular weight addition polymer consists essentially of polymerized 1,2-epoxybutane.

6. A process according to Claim 2 wherein the polymerized 1,2-epoxybutane is added in an amount from 0.05 percent to 1.0 percent by weight.

7. A process according to Claim 6 wherein the polymerized 1,2-epoxybutane is added in an amount from 0.1 percent to 0.5 percent by weight.

8. A process according to Claim 1 wherein the hydrocarbon liquid is a metal cutting fluid.

9. A composition of matter comprising a hydrocarbon liquid and an effective amount to prevent the formation of a dispersion thereof upon application of shock or stress thereto of a high molecular weight addition polymer comprising polymerized 1,2-epoxybutane.