

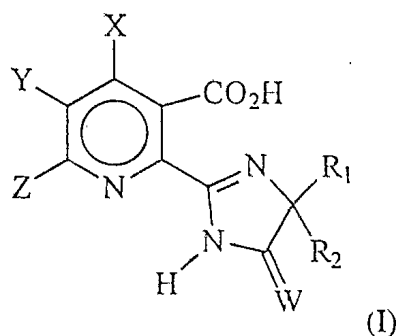


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HERBICIDAL EMULSIFIABLE CONCENTRATE COMPOSITIONS OF IMIDAZOLINONE HERBICIDES
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- (56) Prior Art Documents
US 4749404
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- (57) Claim

1. A herbicidal emulsifiable concentrate composition comprising 0.5% to 5% by weight of an imidazolinyl acid; 0% to 40% by weight of a 2,6-dinitroaniline derivative; 2% to 6% by weight of an alkylarylsulfonic acid, with the proviso that said alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight percent of said imidazolinyl acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigelation agent; and an aromatic solvent; wherein the imidazolinyl acid has the structural formula (I) below



wherein

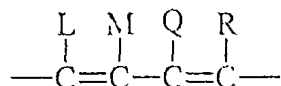
W is oxygen or sulfur;

R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

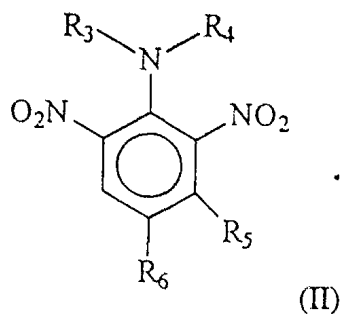
X is hydrogen, halogen, hydroxyl or methyl;

Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro, cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken together, Y and Z may form a ring in which YZ are represented by the structure: $-(CH_2)_n-$, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄ alkoxy;

and the 2,6-dinitroaniline derivative has the structural formula (II) below



wherein

R₃ is hydrogen, C₂-C₄ alkyl or chloroethyl;

R₄ is C₂-C₅ alkyl, chloroethyl, 2-methylallyl or cyclopropylmethyl;

R₅ is hydrogen, methyl or amino;

R₆ is trifluoromethyl, C₁-C₃ alkyl, -SO₂NH₂ or SO₂CH₃.

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COMPLETE SPECIFICATION

FOR A STANDARD PATENT

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Invention Title:

Herbicidal Emulsifiable Concentrate Compositions of
Imidazolinone Herbicides

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

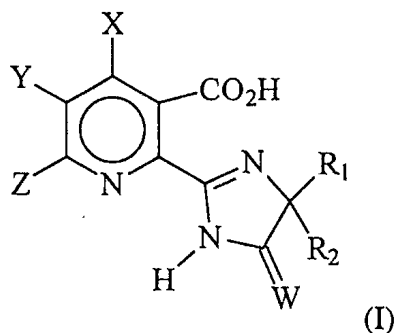
HERBICIDAL EMULSIFIABLE CONCENTRATE COMPOSITIONS
OF IMIDAZOLINONE HERBICIDES

BACKGROUND OF THE INVENTION

5 United States Patent 4,749,404 describes
herbicidal liquid concentrate compositions of salts of
2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-3-qui-
nolinecarboxylic acid which may be combined with an
organic dinitroaniline composition and United States
Patent 4,822,405 describes concentrated oil in water
10 emulsion combination compositions of water soluble
salts of imidazolinone herbicides and dinitroaniline
herbicides. However, the ratio of herbicides which may
be employed is limited because of problems with
crystallization which may occur with more concentrated
15 formulations especially when storing the compositions
at low temperatures. In addition, these compositions
employ salts of imidazolinones and require both aqueous
and organic solvents.

Summary of the Invention

According to a first embodiment of this invention there is provided a herbicidal emulsifiable concentrate composition comprising 0.5% to 5% by weight of an imidazoliny acid; 0% to 40% by weight of a 2,6-dinitroaniline derivative; 2% to 6% by weight of an alkylarylsulfonic acid with the proviso that said alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight percent of said imidazoliny acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigelation agent; and an aromatic solvent; wherein the imidazoliny acid has the structural formula (I) below



wherein

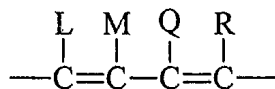
W is oxygen or sulfur;

R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

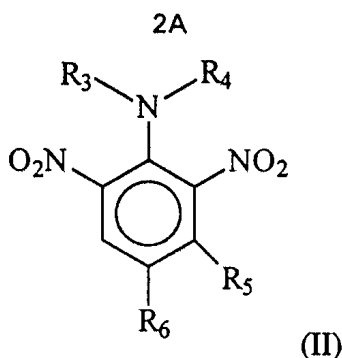
X is hydrogen, halogen, hydroxyl or methyl;

Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro, cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken together, Y and Z may form a ring in which YZ are represented by the structure: -(CH₂)_n-, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄ alkoxy;

and the 2,6-dinitroaniline derivative has the structural formula (II) below



wherein

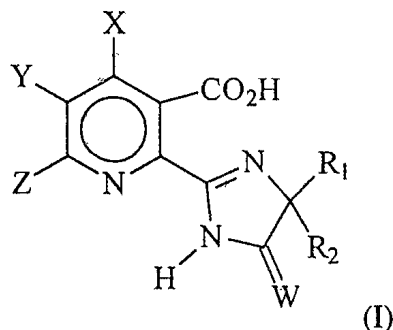
R₃ is hydrogen, C₂-C₄ alkyl or chloroethyl;

R₄ is C₂-C₅ alkyl, chloroethyl, 2-methallyl or cyclopropylmethyl;

5 R₅ is hydrogen, methyl or amino;

R₆ is trifluoromethyl, C₁-C₃ alkyl, -SO₂NH₂ or SO₂CH₃.

According to a second embodiment of this invention there is provided a method of preparing a herbicidal emulsifiable concentrate composition comprising admixing 0.5% to 5% by weight of an imidazoliny acid; 0% to 40% by weight of a 2,6-dinitroaniline
10 derivative; 2% to 6% by weight of an alkylarylsulfonic acid with the proviso that said alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight percent of said imidazoliny acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigellation agent; and an aromatic solvent; wherein the imidazoliny acid has the structural formula (I) below



wherein

W is oxygen or sulfur;

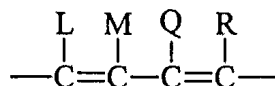
R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with
20 the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

X is hydrogen, halogen, hydroxyl or methyl;

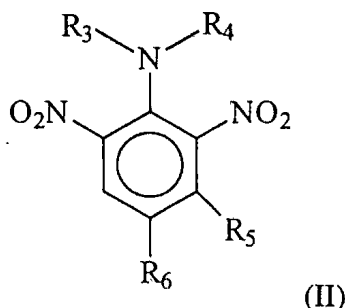
Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro,
25 cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken

together, Y and Z may form a ring in which YZ are represented by the structure:
 $-(CH_2)_n-$, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄
 5 alkoxy;

and the 2,6-dinitroaniline derivative has the structural formula (II) below



wherein

R₃ is hydrogen, C₂-C₄ alkyl or chloroethyl;

10 R₄ is C₂-C₅ alkyl, chloroethyl, 2-methallyl or cyclopropylmethyl;

R₅ is hydrogen, methyl or amino;

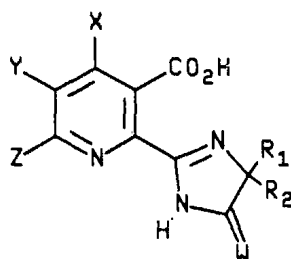
R₆ is trifluoromethyl, C₁-C₃ alkyl, -SO₂NH₂ or SO₂CH₃.

It is therefore an object of the present invention to advantageously provide an
 emulsifiable concentrate combination composition in which all of the active herbicidal
 15 agents are dissolved in a single solvent which may be stored at lower temperatures and for
 a longer period of time than suspension concentrate compositions or concentrated oil in
 water emulsion compositions.

It is also an object of the present invention to provide herbicidal emulsifiable
 concentrate compositions of free acids of imidazolinone herbicides and 2,6-dinitroaniline
 20 herbicides which are physically and chemically stable.

Detailed Description of the Invention

An embodiment of the invention is herbicidal emulsifiable concentrate compositions
 comprising on a weight basis about 0.5% to 5% of an imidazolinyl acid represented by
 structural formula I



(I)

wherein

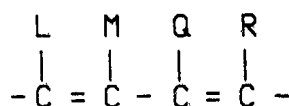
W is oxygen or sulfur;

R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

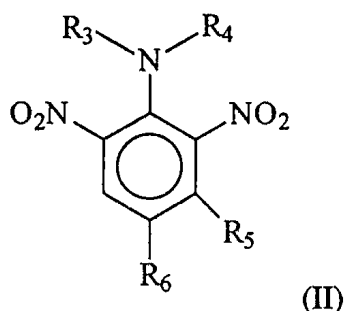
X is hydrogen, halogen, hydroxyl or methyl;

Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro, cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken together, Y and Z may form a ring in which YZ are represented by the structure: -(CH₂)_n-, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄ alkoxy;

0% to 40% of a herbicidal 2,6-dinitroaniline derivative represented by structural formula II



wherein

- 5 R_3 is hydrogen, C_2 - C_4 alkyl or chloroethyl;
 R_4 is C_2 - C_5 alkyl, chloroethyl, 2-methallyl or cyclopropylmethyl;
 R_5 is hydrogen, methyl or amino;
 R_6 is trifluoromethyl, C_1 - C_3 alkyl, $-SO_2NH_2$ or SO_2CH_3 .

2% to 6% of an alkylarylsulfonic acid; 2% to 6% of an ethylene oxide/propylene oxide
 10 block copolymer; 1% to 6% of an alkylphenol polyethylene oxide condensate; 0.5% to
 10% of an antigelation agent and a sufficient amount of an aromatic solvent to total
 100%.

A most preferred embodiment of the present invention comprises on a weight basis
 0.5% to 5% of a formula I imidazoliny acid, 20% to 40% of a formula II 2,6-
 15 dinitroaniline derivative, 2% to 6% of an alkylarylsulfonic acid with the proviso that said
 alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight
 percent of the imidazoliny acid, 2% to 6% of an ethylene oxide/propylene oxide block
 copolymer, 1% to 6% of an alkylphenol polyethylene oxide condensate, 0.5% to 10% of
 an antigelation agent and a sufficient amount of an aromatic solvent to total 100%.

Surprisingly, it has been found that the compositions of the present invention provide physically and chemically stable herbicidal emulsifiable concentrate compositions of formula (I) imidazolinyl acids and formula (II) 2,6-dinitroaniline derivatives which remain free-flowing and homogeneous for extended periods of time, and also remain physically and chemically stable after repeated freezing and thawing cycles without precipitating insoluble solids.

The alkylarylsulfonic acid of the present invention is an especially important element of the present compositions and should be present in at least an amount equal to about 1.2 times the percent by weight of the imidazolinyl acid to ensure that the acid completely dissolves in the aromatic solvent. Alkylarylsulfonic acids suitable for use in the compositions of the invention include C_8 - C_{18} alkylbenzenesulfonic acids, with dodecylbenzenesulfonic acid being most preferred.

Antigelation agents are used in the compositions of the present invention to ensure that the compositions remain homogeneous and free-flowing. Antigellation agents which are suitable for use in the compositions of the present invention include N-methylpyrrolidone, cyclohexanone, alcohols such as ethanol and methanol, glycols such as propylene glycol and ethylene glycol and the like with N-methylpyrrolidone being most preferred.

A preferred group of ethylene oxide/propylene oxide block copolymers suitable for use in the compositions of the present invention are

butyl-omega-hydroxypoly(oxypropylene)block polymer with poly(oxyethylene) having an average molecular weight in a range of 2,400 to 3,500, with alpha-butyl-omega-hydroxy-ethylene oxide-propylene oxide block copolymers having an HLB of 12 and a viscosity at 25°C of 2,000 CPS, (TOXIMUL® 8320, Stepan Chemical Co.) being a most preferred member of this class of emulsifiers.

Preferred alkylphenol polyethylene oxide condensates suitable for use in the compositions of the present invention are the nonylphenol ethoxylates, with nonylphenol ethoxylate (9 to 10 mols of ethylene oxide) (FLO MO®9N, DeSoto, Inc., Sellers Chemical Div.) being a most preferred member of this class of emulsifiers.

Aromatic solvents suitable for use in the compositions of this invention include aromatic hydrocarbon and chlorinated aromatic hydrocarbon solvents and mixtures thereof; such as toluene, xylenes, polynuclear aromatic hydrocarbons such as naphthalenes and alkyl-naphthalenes and mixtures thereof, many of which are available from the fractionation of crude oil and in general have distillation ranges in the temperature range of from about 140°C to 305°C, with those having a distillation range of from about 183°C to 280°C being most preferred, and are commercially available under a variety of tradenames; and mono or polychlorobenzene and toluenes.

ImidazolinyI acids particularly useful in the compositions of the present invention are 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-3-quinoline-carboxylic acid, 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid, 2-(4-isopropyl-

4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid and
2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-
(methoxymethyl)nicotinic acid.

5 2,6-Dinitroaniline derivatives which are especial-
ly suitable for use in the compositions of the present
invention are pendimethalin and trifluralin.

10 The emulsifiable concentrate compositions of the
present invention may conveniently be prepared by
admixing the formula (I) imidazolinyl acid with a
solution of the desired antigelation agent, alkyl-
arylsulfonic acid, ethylene oxide/propylene oxide block
15 copolymer, alkylphenol polyethylene oxide condensate
and aromatic solvent until all of the solids are
dissolved, then the formula (II) 2,6-dinitroaniline
derivative is added to the solution and mixing is
continued until a homogeneous solution is obtained.

20 The following examples are provided to further
illustrate the compositions of the present invention
but are not limitative of the invention described
herein.

EXAMPLE 1

Preparation of herbicidal emulsifiable concentrate compositions

5 Solid 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid (2.62g, 93.4% pure, 2.62% on a weight basis) is added to a stirred solution of N-methylpyrrolidone (4g, 4% on a weight basis) and dodecylbenzenesulfonic acid (4g, 4% on a weight basis). The mixture is stirred until all of the solids dissolve. An aromatic hydrocarbon mixture (C₁₀ to C₁₃) aromatics having a distillation range of from about 226°-279°C (AROMATIC® 200, Exxon) (45.68g, 45.68% on a weight basis) is added to the mixture and stirring is continued until a homogeneous solution of obtained. Pendimethalin (35.7g, 92.3% pure, 35.7% on a weight basis) is added to the homogeneous solution and stirring is continued until the solids dissolve. Next, 15 nonylphenol ethoxylate (9 to 10 mols of ethylene oxide) (4g, 4% on a weight basis) and alpha-butyl-omega-hydroxy-ethylene oxide propylene oxide block copolymer having a HLB of 12 and a viscosity at 25°C of 2,000 CPS (4g, 4% on a weight basis) are added to the 20 mixture and stirring is continued until a homogeneous solution is obtained which is then filtered through 1.5 micron filter paper to obtain a clear dark brown solution having a density at 20°C of 1.0683 g/mL.

25 Following the procedure of Example 1, but using the compounds listed in Table I below gives the emulsifiable concentrate compositions listed in Table II below.

TABLE I

Herbicidal Imidazoliny Acid

- a. 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid

5

Herbicidal 2,6-Dinitroaniline Derivative

- b. pendimethalin
c. trifluralin

Alkylarylsulfonic Acid

10

- d. dodecylbenzene sulfonic acid

Antigelation Agent

- e. N-methylpyrrolidone
f. cyclohexanone
g. dipropylene glycol

15

Ethylene Oxide/propylene Oxide Block Copolymer

- h. alpha-butyl-omega-hydroxy-ethylene oxide-propylene oxide block copolymer having an HLB of 12 and a viscosity at 25°C of 2,000 CPS

20

Alkylphenol Polyethylene Oxide Condensate

- i. nonylphenol ethoxylate (6 mols of ethylene oxide)
j. nonylphenol ethoxylate (9-10 mols of ethylene oxide)
k. nonylphenol ethoxylate (11 mols of ethylene oxide)

25

- l. nonylphenol ethoxylate (13 mols of ethylene oxide)
- m. nonylphenol ethoxylate (15 mols of ethylene oxide)
- 5 n. nonylphenol ethoxylate (30 mols of ethylene oxide)

Aromatic Solvent

- 10 o. aromatic hydrocarbon mixture (C_{10} to C_{13} aromatics, distillation range 226° - 279° C) (AROMATIC®200, Exxon)
- 15 p. aromatic hydrocarbon mixture (C_9 to C_{12} aromatics, distillation range 183° - 210° C) (AROMATIC®150, Exxon)

TABLE II
Emulsifiable Concentrate Compositions

Compo- sition	Imidazo-	2,6-Dinitro-	Alkylaryl-	Anti-	Ethylene oxide/ propylene	Alkylphenol	Aromatic
	linyl acid/ % W/W		sulfonic acid/ % W/W	gelation agent/ % W/W	oxide block copolymer/ % W/W	polyethylene oxide Conden- sate/% W/W	
1	a/2.62	b/35.70	d/4.0	e/4.0	h/4.0	j/4.0	o/45.68
2	a/2.40	b/33.40	d/4.0	e/8.0	h/4.0	j/4.0	o/44.20
3	a/2.60	b/35.80	d/4.0	e/8.0	h/4.0	j/2.0	o/43.60
4	a/2.40	b/33.40	d/4.0	e/4.0	h/4.0	j/4.0	o/48.20
5	a/2.40	b/33.40	d/4.0	e/4.0	h/3.0	j/4.0	o/49.20
6	a/2.40	b/33.40	d/4.0	e/4.0	h/2.0	j/4.0	o/50.20
7	a/2.40	b/33.40	d/4.0	e/4.0	h/3.0	j/3.0	o/50.20
8	a/2.40	b/33.40	d/4.0	e/4.0	h/2.0	j/3.0	o/51.20
9	a/2.60	b/35.80	d/4.0	e/0.5	h/4.0	j/4.0	o/50.90
10	a/2.60	b/35.80	d/4.0	f/1.0	h/4.0	j/4.0	o/48.60
11	a/2.60	b/35.80	d/4.0	g/1.0	h/4.0	j/4.0	o/48.60
12	a/2.60	b/35.80	d/4.0	e/8.0	h/4.0	n/1.0	o/44.60
13	a/2.50	b/34.60	d/4.0	e/1.0	h/4.0	n/1.0	o/51.90
14	a/2.65	c/29.66	d/3.0	e/2.0	h/3.0	j/3.0	p/56.69

TABLE II (continued)

Compo- sition	Imidazo-	2,6-Dinitro- aniline/ % W/W	Alkylaryl- sulfonic acid/ % W/W	Anti- gelation agent/ % W/W	Ethylene oxide/ propylene		Aromatic Solvent/ % W/W
	linyl acid/ % W/W				oxide block copolymer/ % W/W	Alkylphenol polyethylene oxide Conden- sate/% W/W	
15	a/2.65	c/29.66	d/3.0	e/4.0	h/3.0	j/3.0	p/54.69
16	a/2.45	c/29.66	d/3.0	e/4.0	h/3.0	i/3.0	p/54.89
17	a/2.45	c/29.66	d/3.0	e/4.0	h/3.0	k/3.0	p/54.89
18	a/2.45	c/29.66	d/3.0	e/4.0	h/3.0	l/3.0	p/54.89
19	a/2.45	c/29.66	d/3.0	e/4.0	h/3.0	m/3.0	p/54.89
20	a/2.62	c/29.66	d/4.0	e/8.0	h/4.0	j/4.0	p/47.72
21	a/2.45	c/29.44	d/3.0	e/4.0	h/3.0	j/3.0	o/55.11

EXAMPLE 2

Low temperature stability of emulsifiable concentrate compositions of the invention

Two 10mL samples of compositions 2 and 4 prepared in the above example are placed in a constant temperature bath maintained at 5°C and the temperature of the samples is allowed to equilibrate for two hours. Seeds of pendimethalin crystals and 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid powder are added to the samples. After 48 hours, the samples are visually inspected for evidence of crystallization. The temperature of the bath is then lowered in 1°C increments holding the sample at each temperature for 48 hours until crystallization is observed. A comparative control composition containing on a weight basis 31.71% pendimethalin, 2.26% 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid, 0.5% ammonium hydroxide, 27.42% aromatic mixture (AROMATIC® 200, Exxon), 6.04% surfactants and 32.07% water is also evaluated similarly except the initial testing temperature is set at 15°C instead of 5°C. The results of these experiments are summarized in Table III below.

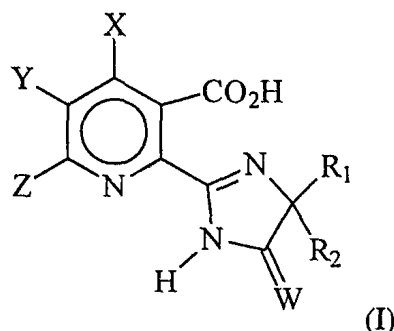
TABLE III

Low Temperature Experiments

<u>Composition</u>	<u>Crystallization Temperature °C</u>
Control	13°C
2	-1°C
4	-3°C
9	0°C
11	0°C

The claims defining the invention are as follows:-

1. A herbicidal emulsifiable concentrate composition comprising 0.5% to 5% by weight of an imidazoliny acid; 0% to 40% by weight of a 2,6-dinitroaniline derivative; 2% to 6% by weight of an alkylarylsulfonic acid with the proviso that said
5 alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight percent of said imidazoliny acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigellation agent; and an aromatic solvent; wherein the imidazoliny acid has the structural formula (I) below



10 wherein

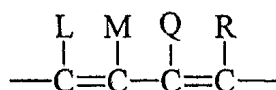
W is oxygen or sulfur;

R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with
15 the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

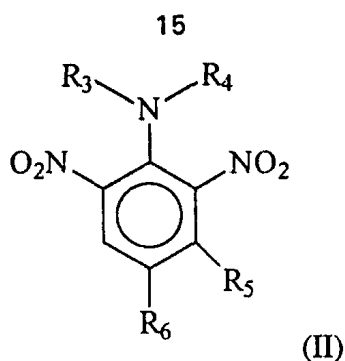
X is hydrogen, halogen, hydroxyl or methyl;

Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro, cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl
20 optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken together, Y and Z may form a ring in which YZ are represented by the structure:
-(CH₂)_n-, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄
25 alkoxy;

and the 2,6-dinitroaniline derivative has the structural formula (II) below



wherein

R₃ is hydrogen, C₂-C₄ alkyl or chloroethyl;

R₄ is C₂-C₅ alkyl, chloroethyl, 2-methallyl or cyclopropylmethyl;

5 R₅ is hydrogen, methyl or amino;

R₆ is trifluoromethyl, C₁-C₃ alkyl, -SO₂NH₂ or SO₂CH₃.

2. The composition according to Claim 1 comprising on a weight basis 2% to 6% of the ethylene oxide/propylene oxide block copolymer, 1% to 6% of the alkylphenol polyethylene oxide condensate, 0.5% to 10% of the antigelation agent and a sufficient
10 amount of the aromatic solvent to total 100%.

3. The composition according to Claim 2 comprising on a weight basis 20% to 40% of the 2,6-dinitroaniline derivative.

4. The composition according to Claim 3 wherein the alkylarylsulfonic acid is a C₈-C₁₈ alkylbenzenesulfonic acid, the ethylene oxide/propylene oxide block copolymer is
15 a butyl-omega-hydroxy-poly-(oxypropylene) block polymer with poly (oxyethylene), the alkylphenol polyethylene oxide condensate is a nonylphenol ethoxylate, the antigelation agent is N-methylpyrrolidone, cyclohexanone, an alcohol or a glycol and the aromatic solvent is an aromatic hydrocarbon mixture having a distillation range of from 140°C to 305°C.

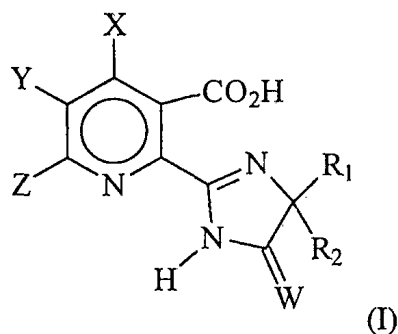
20 5. The composition according to Claim 4 wherein the C₈-C₁₈ alkylbenzenesulfonic acid is dodecylbenzenesulfonic acid, the butyl-omega-hydroxy-poly (oxypropylene) block polymer with poly (oxyethylene) is alpha-butyl-omega-hydroxy-ethylene oxide-propylene oxide block copolymer having a HLB of 12 and a viscosity at 25 °C of 2,000 CPS, the nonylphenol ethoxylate is nonylphenol ethoxylate (9 to 10 mols of
25 ethylene oxide), the antigelation agent is N-methylpyrrolidone, and the aromatic hydrocarbon mixture has a distillation range of from 183°C to 280°.

6. The composition according to Claim 4 wherein the imidazoliny acid is selected from the group consisting of 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-3-quinolinecarboxylic acid, 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)
30 nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid and 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl) nicotinic acid; and the 2, 6-dinitroaniline derivative is selected from the group consisting of pendimethalin and trifluralin.

7. The composition according to Claim 6 wherein the imidazoliny acid is 5-ethyl-2-(4-iso-propyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid and the 2,6-dinitroaniline derivative is pendimethalin.

8. The composition according to Claim 6 wherein the imidazoliny acid is 5-ethyl-2-(4-iso-propyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid and the 2,6-dinitroaniline derivative is trifluralin.

9. A method of preparing a herbicidal emulsifiable concentrate composition comprising admixing 0.5% to 5% by weight of an imidazoliny acid; 0% to 40% by weight of a 2, 6-dinitroaniline derivative; 2% to 6% by weight of an alkylarylsulfonic acid with the proviso that said alkylarylsulfonic acid is present in at least an amount equal to 1.2 times the weight percent of said imidazoliny acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigelation agent; and an aromatic solvent; wherein the imidazoliny acid has the structural formula (I) below



wherein

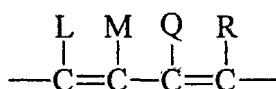
W is oxygen or sulfur;

R₁ is C₁-C₄ alkyl;

R₂ is C₁-C₄ alkyl or C₃-C₆ cycloalkyl; and when R₁ and R₂ are taken together with the carbon to which they are attached they may represent C₃-C₆ cycloalkyl optionally substituted with methyl;

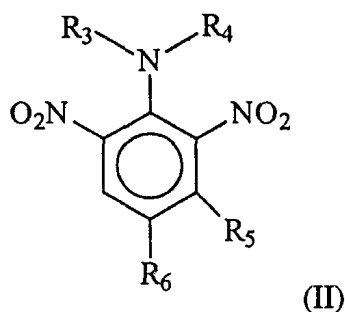
X is hydrogen, halogen, hydroxyl or methyl;

Y and Z are independently hydrogen, halogen, C₁-C₆ alkyl, C₁-C₄ alkoxyalkyl, hydroxyloweralkyl, C₁-C₆ alkoxy, C₁-C₄ alkylthio, phenoxy, C₁-C₄ haloalkyl, nitro, cyano, C₁-C₄ alkylamino, diloweralkylamino, or C₁-C₄ alkylsulfonyl group or phenyl optionally substituted with one C₁-C₄ alkyl, C₁-C₄ alkoxy or halogen; and when taken together, Y and Z may form a ring in which YZ are represented by the structure: -(CH₂)_n-, where n is an integer of 3 or 4, provided that X is hydrogen; or



where L, M, Q and R are independently hydrogen, halogen, C₁-C₄ alkyl or C₁-C₄ alkoxy;

and the 2,6-dinitroaniline derivative has the structural formula (II) below



wherein

R₃ is hydrogen, C₂-C₄ alkyl or chloroethyl;

5 R₄ is C₂-C₅ alkyl, chloroethyl, 2-methallyl or cyclopropylmethyl;

R₅ is hydrogen, methyl or amino;

R₆ is trifluoromethyl, C₁-C₃ alkyl, -SO₂NH₂ or SO₂CH₃.

10. A herbicidal emulsifiable concentrate composition, substantially as hereinbefore described with reference to any one of the Examples.

10 11. A method of preparing a composition of Claim 1 which method is substantially as herein described with reference to Example 1.

Dated 6 July, 1994
American Cyanamid Company

Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

HERBICIDAL EMULSIFIABLE CONCENTRATE COMPOSITIONS
OF IMIDAZOLINONE HERBICIDES

ABSTRACT

5 The present invention provides herbicidal emulsifiable concentrate compositions comprising about 0.5% to 5% by weight of an imidazolinyl acid; 0% to about 40% by weight of a 2,6-dinitroaniline derivative; 2% to 6% by weight of an alkylarylsulfonic acid; ethylene oxide/propylene oxide block copolymer and alkylphenol polyethylene oxide condensate emulsifying agents; an antigellation agent; and an aromatic solvent.