WE CLAIM:

1. An acid-in-oil emulsion composition comprising:

20 gallons per thousand gallons to 40 gallons per thousand gallons of an emulsifying agent, the emulsifying agent comprising an organic oligomer or polymer that has succinic acid groups covalently bonded to it and an alkylamine ethoxylated surfactant or the emulsifying agent comprising a polyisobutylene ethanolamide;

2 gallons per thousand gallons to 4 gallons per thousand gallons of a dispersion agent, the dispersion agent being represented by general formula (6): $R\text{-}(OCH_2CH_2)_n\text{-}OH$ (6) wherein R is a straight or branched chained C2 to C30 alkyl group and n is an integer from 1 and 20;

10% to 50% by volume of a base oil;

55% to 85% by volume of an acid; and

1 gallon per thousand gallons to 4 gallons per thousand gallons by volume of a corrosion inhibitor; wherein the acid-in-oil emulsion composition is substantially devoid of priority pollutants; and

the acid-in-oil emulsion composition exhibits a fluid viscosity as a function of a shear rate of the acid in the acid-in-oil emulsion composition between 40 cP and 125 cP at a shear rate of 20 sec^{-1} to 511 sec^{-1} and a temperature between 80°F and 180°F.

2. The acid-in-oil emulsion composition as claimed in claim 1, where the emulsifying agent is polyisobutylene ethanolamide.

3. The acid-in-oil emulsion composition as claimed in claim 1, where the emulsifying agent comprising an organic oligomer or polymer that has succinic acid groups covalently bonded to it and an alkylamine ethoxylated surfactant, and the organic oligomer or polymer is selected from the group consisting of polyacetals, polyolefins, polyacrylics, polycarbonates, polystyrenes, polyesters, polyamides, polyamideimides, polyarylates, polyarylsulfones, polyethersulfones, polyphenylene sulfides, polyvinyl chlorides, polysulfones, polyimides, polyetherimides, polyisoprenes, polybutadienes, polyisobutylenes, or a combination comprising one or more of the foregoing oligomers or polymers.

4. The acid-in-oil emulsion composition as claimed in claim 3, where the organic oligomer or polymer that has succinic acid groups covalently bonded to it is a polyisobutylene succinic acid; a polyisobutylene succinic acid reacted with water; a polyisobutylene succinic acid amine salt obtained by reacting the polyisobutylene succinic acid with either an alkyl amine, an ethanolamine or an ethoxylated amine; a polyisobutylene

succinic aminoalkylester or ester-acid or amine salt prepared by reacting the polyisobutylene succinic acid or an ester thereof with a hydroxylamine or an alkanol amine; a polyisobutylene succinimide or succinamide or amide-acid salt thereof derived by reacting polyisobutylene succinic acid with an amine or poly amine; or a polyisobutylene succinic ester derived by reacting polyisobutylene with a polyol.

5. The acid-in-oil emulsion composition as claimed in claim 3, where the alkylamine ethoxylated surfactant may be derived from a mono-or a di-amine and has the general Formula (4) or (5)

$R—N(E_aH)—(CH_2)_x-N(E_bH)(E_cH)$ (4) or

$R—N(E_aH)(E_bH)$ (5).

wherein R comprises a C8 to C30 straight or branched alkyl group; N represents a nitrogen atom; E is an ethoxylate group; where x=1, 2, or 3; and a, b, c, is any integer between 0 and 20 such that: a+b+c has any value between 1 and 20.

6. The acid-in-oil emulsion composition as claimed in claim 1, wherein in formula (6) R is a straight or branched C6 to C20 alkyl group; and n is an integer of 2 to 10.

7. The acid-in-oil emulsion composition as claimed in claim 1, wherein the dispersion agent is derived from ethylene oxide and lauryl alcohol.

8. The acid-in-oil emulsion composition as claimed in claim 1, wherein the base oil comprises a C11-C16 olefin-paraffin blend.

9. The acid-in-oil emulsion composition as claimed in claim 1, wherein the acid is a mineral acid, an organic acid, or a combination comprising one or more of the foregoing acids.

10. The acid-in-oil emulsion composition as claimed in claim 1, wherein the acid is an aqueous mineral acid, hydrochloric acid, hydrofluoric acid, sulfamic acid, an organic acid, an organic acid-mineral acid blend, an organic acid-hydrofluoric acid blend or a combination comprising one or more of the foregoing.

11. The acid-in-oil emulsion composition as claimed in claim 1, wherein the acid-in-oil emulsion composition forms a heat-stable emulsion comprising an external oil phase and an internal acid phase at temperatures between 180°F and 400°F.

12. A method for treating a hydrocarbon-bearing formation comprising:

blending an emulsifying agent, a base oil and an acid to produce an acid-in-oil emulsion of claim 1, the acid-in-oil emulsion being substantially devoid of priority pollutants; and

discharging the acid-in-oil emulsion into a downhole hydrocarbon-bearing well formation, where the acid-in-oil emulsion is operative to stimulate hydrocarbon production.

13. The method as claimed in claim 12, wherein the acid-in-oil emulsion comprises an external oil phase and an internal acid phase and is heat-stable at temperatures between 180°F and 400°F.

14. The acid-in-oil emulsion composition as claimed in claim 1 comprising,

25 gallons per thousand gallons to 35 gallons per thousand gallons of the emulsifying agent;

2 gallons per thousand gallons to 4 gallons per thousand gallons of the dispersion agent; the dispersion agent being represented by $R-(OCH_2CH_2)_n-OH$ (6) wherein R is a straight or branched chained C2 to C30 alkyl group and n is an integer from 1 and 20;

25% to 35% by volume of the base oil; the base oil comprising a C11-C16 olefin-paraffin blend; and

60% to 80% by volume of the acid.

15. The acid-in-oil emulsion composition as claimed in claim 1 comprising,

28 gallons per thousand gallons to 32 gallons per thousand gallons of the emulsifying agent;

2 gallons per thousand gallons to 4 gallons per thousand gallons of the dispersion agent;

25% to 35% by volume of the base oil; and

65% to 75% by volume of the acid.

16. The acid-in-oil emulsion composition as claimed in claim 15, wherein the acid is hydrochloride acid.

Dated this 26.02.2015

Payal Kalra

[PAYAL KALRA]
IN/PA-1226
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT(S)

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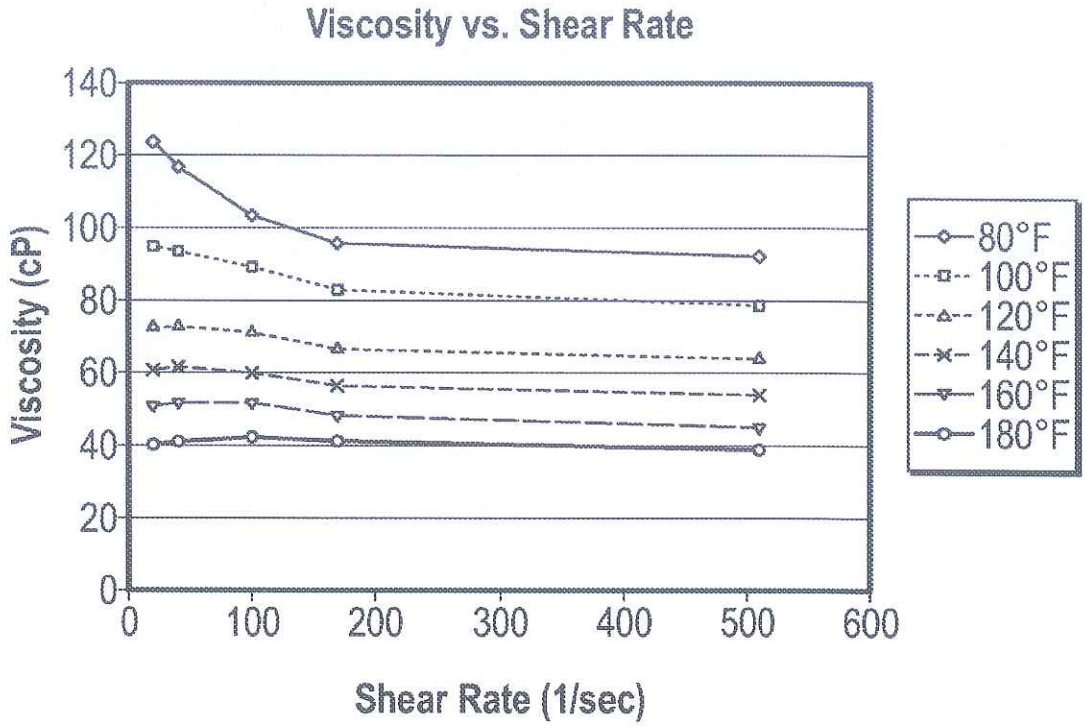


FIG. 1

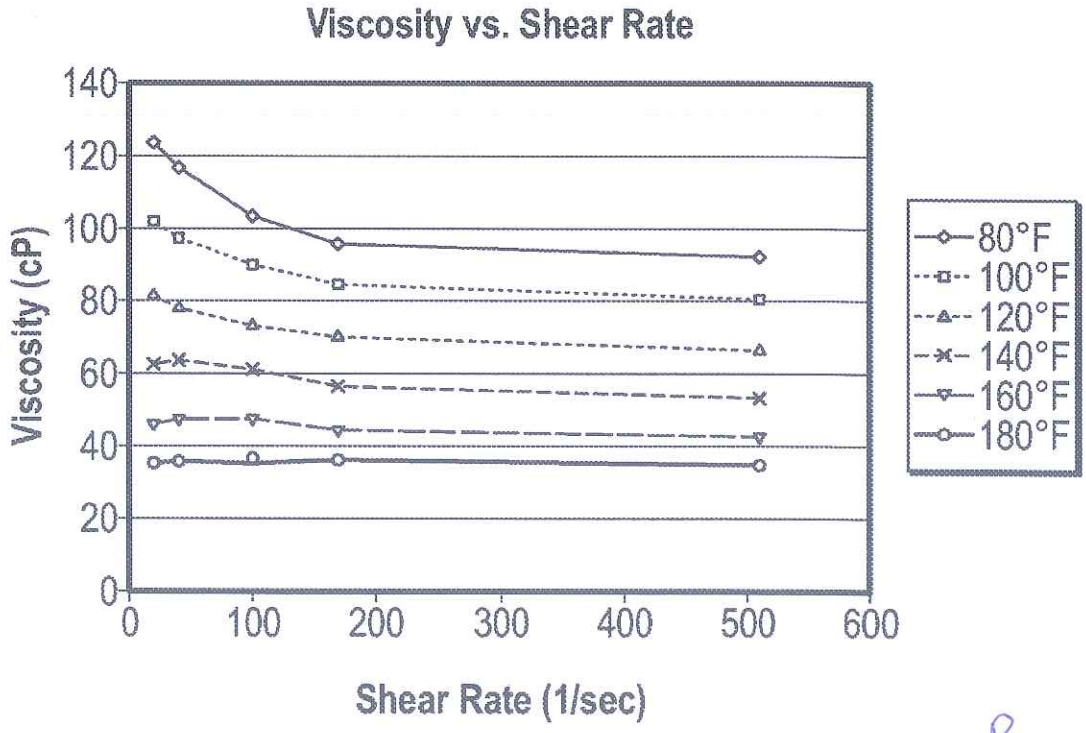


FIG. 2

Payal Kalra.

(PAYAL KALRA)
IN/PA-1226
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]

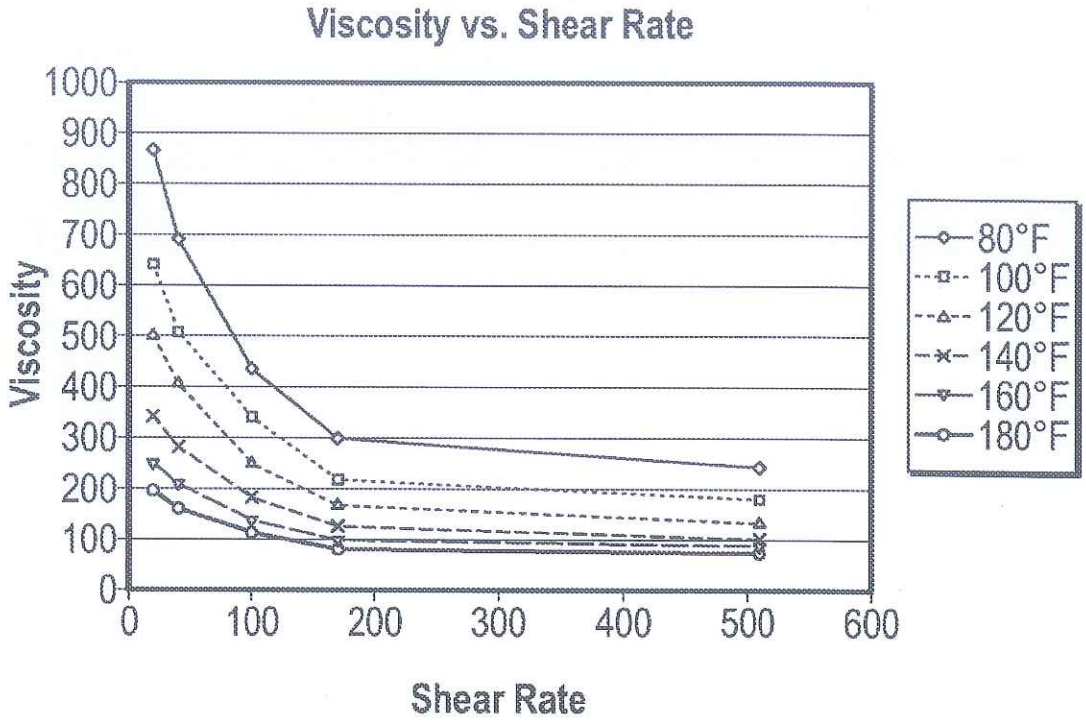


FIG. 3

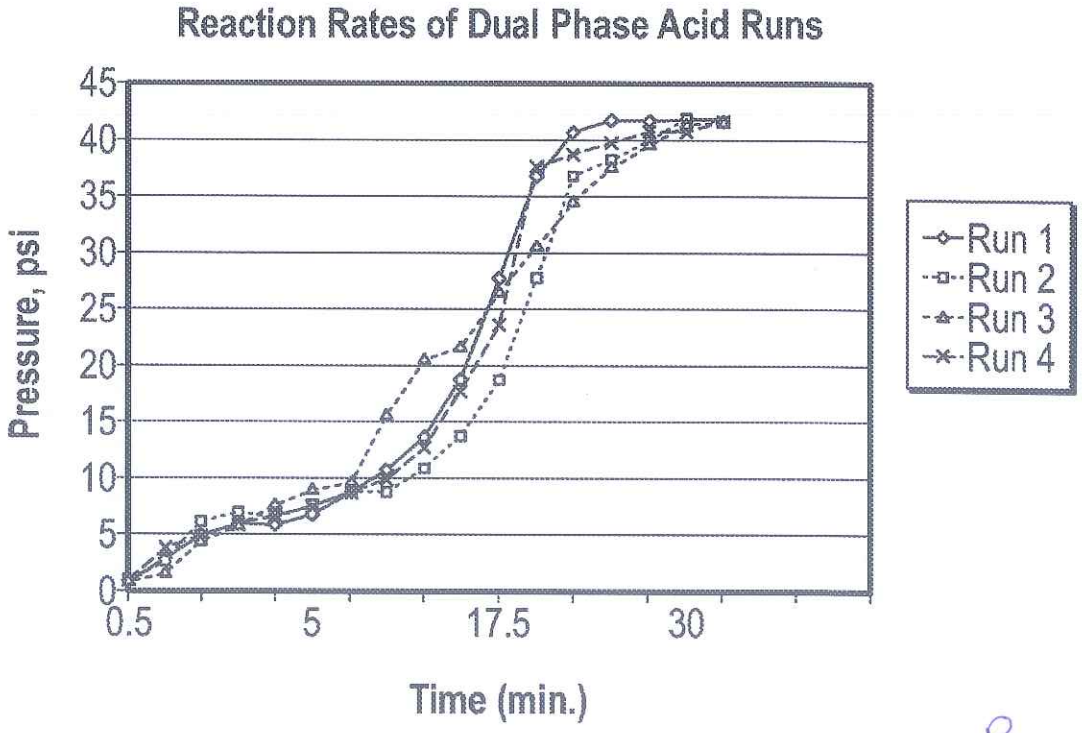


FIG. 4

(PAYAL KALRA)
IN/PA-1226
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]

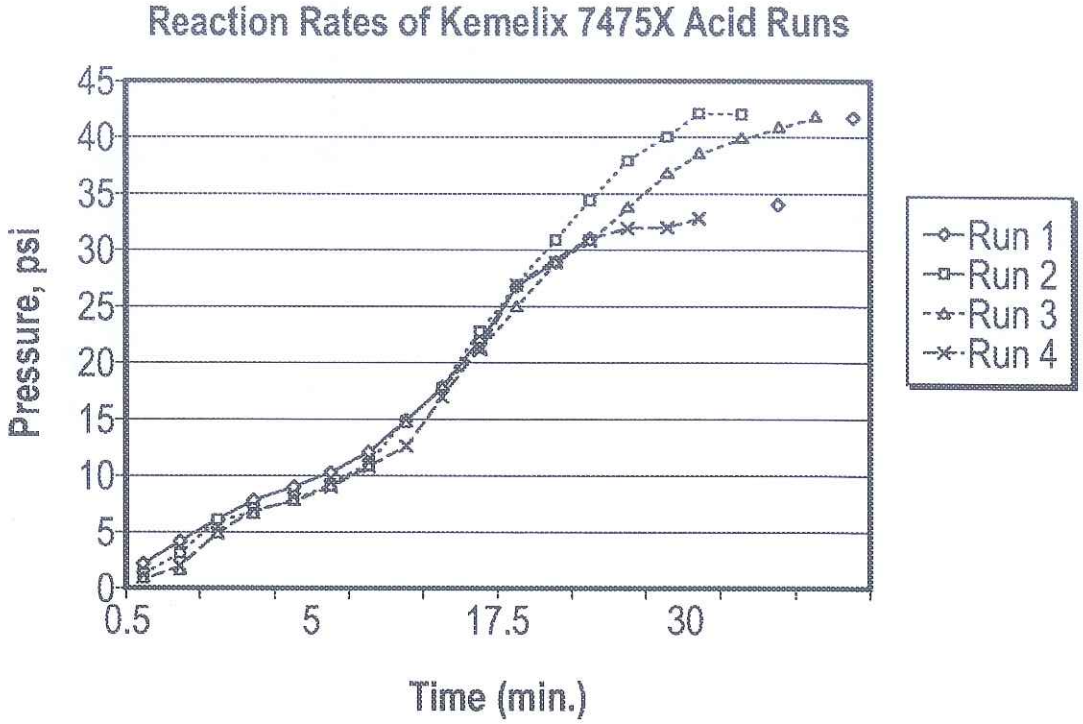


FIG. 5

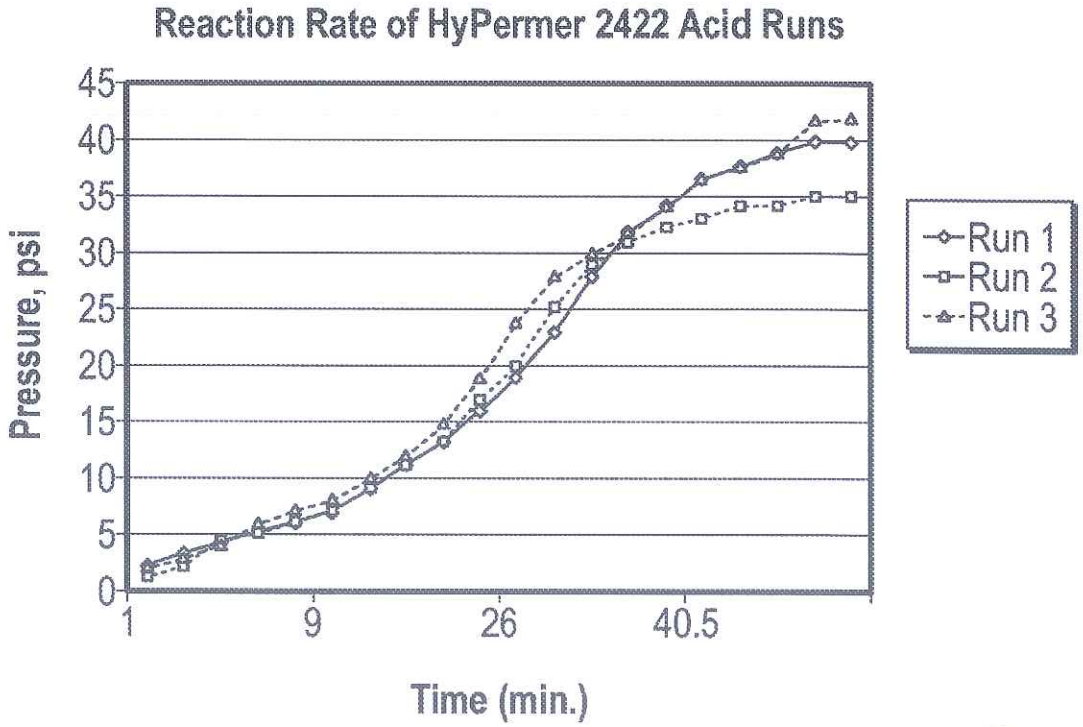


FIG. 6

Payal Kalra

(PAYAL KALRA)
IN/PA-1226
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]

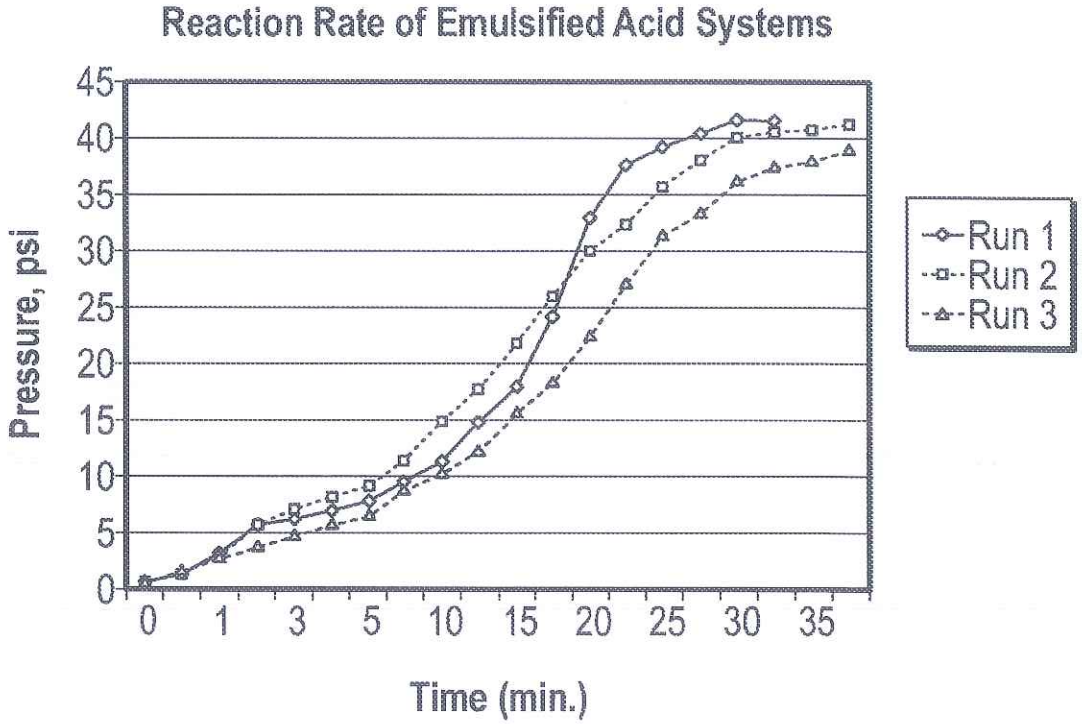


FIG. 7

Payal Kalra

(PAYAL KALRA)
IN/PA-1226
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]