Has Adjuvant Technology Changed?

Adjuvant Technology Trends in Patents 2016 -2019

CPDA Adjuvants and Inerts Conference

Denver, CO

April 30, 2019

R. Scott Tann
President
Phocas LLC

Acknowledgement

patsnap

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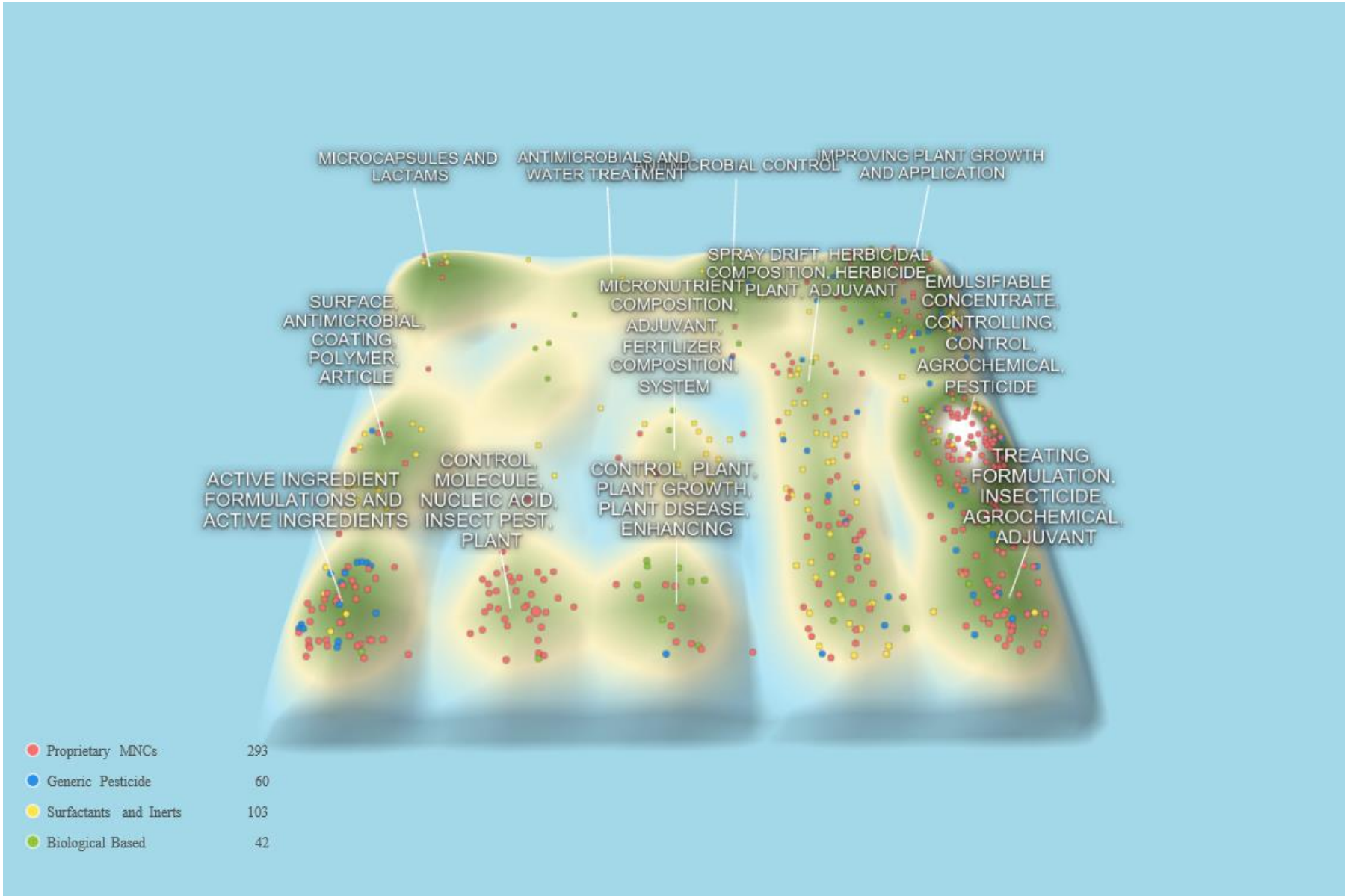
PatSnap has brought together the world's most comprehensive R&D dataset in one easy to use platform to help innovation leaders analyse tech trends, assess new opportunities, conduct competitor intelligence and maximise return on IP assets. By combining millions of data points from patents, licensing, litigation and company information with non-patent literature, PatSnap provides the world's most innovative organisations with a new intuitive source of information to accelerate their R&D.

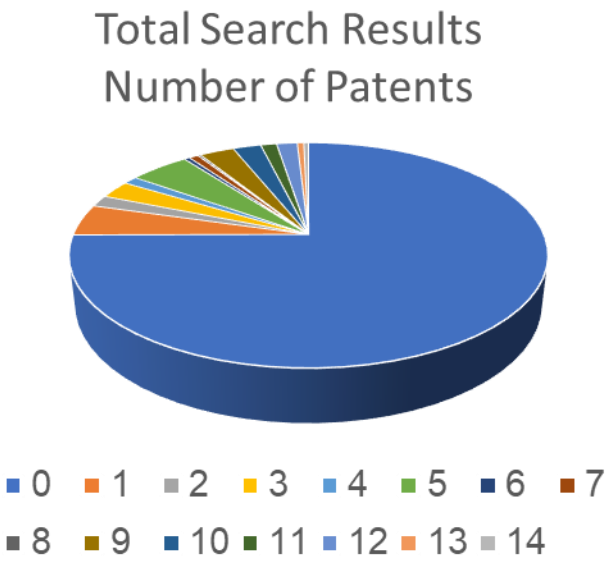
Patent Landscape over past 3 years

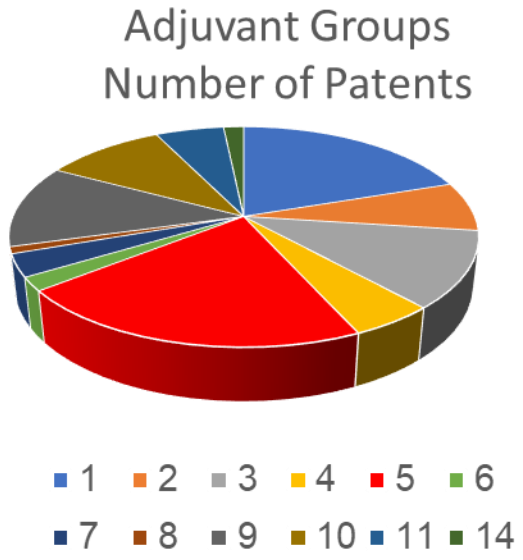


Classification of Patents/Applications

Over 1300 Patents were obtained based on search criteria. Patents were grouped as follows:

- *Group 0 – Pesticide formulations*
- Group 1 – Plant Growth Adjuvants
- Group 2 – Emulsion system adjuvants
- Group 3 – Drift Modifiers
- Group 4 – Vapor Reduction adjuvants
- Group 5 – General Adjuvants
- Group 6 – Lecithin containing adjuvants
- Group 7 – Water Conditioning adjuvants
- *Group 8 – Antifoaming/Defoaming*
- Group 9 – RNAi adjuvants or systems
- Group 10 - Surfactants for adjuvants
- Group 11 – Nanotechnology
- *Group 12 – Seed Treatment*
- *Group 13 – Encapsulation*
- Group 14 - Polymers





Group 1- Plant Growth Adjuvants

Scope: Patents related to delivery of biological material (primarily adjuvants to plants. Specifically not including pest control agents

No. of patents in group: 60

Major trends: Use of solvents, new chelating materials, encapsulation and improved polymers

Publication No.	Title	Novel Feature
US20170172143A1	Choline Chloride in Liquid Guar Formulations	Allows hydration of the guar without the use of traditional nitrogen water conditioners such as AMS
WO2016185380A1	Use of hydroxyapatite as a carrier of bioactive substances for treating vascular diseases in plants	The carbonate substitution, and metal ion substitution, has the advantage of lowering the crystallinity degree of hydroxyapatite, becoming more amorphous. The amorphous state leads to an increase of solubility of the hydroxyapatite structure in a biological environment, improving the release becoming more effective..
US20190008145A1	Non-Aqueous Solution of Plant-Growth Regulator(s) and Polar and/or Semi-Polar Organic Solvent(s)	Improves formulation stability vs. water based systems
US9938201	Micronutrient compositions containing zinc and systems and methods of using same	Prevents precipitation of Zinc in the spray tank
EP2838853A1	A method to stabilize liposome emulsions for biocidal delivery	Targeted for enhanced delivery of biocidal agents in boiler water but could be useful as spray tank adjuvant

Group 2 – Emulsion system adjuvants

Scope: Patents related to the use of solvents or emulsifiable systems

No. of patents in group: 22

Major trends: New solvents, microemulsion technology incorporating drift mitigation polymers, expansion of use of various functional chemistries not previously seen: amides, polyacrylamides and sulfones and sultones

Publication No.	Title	Novel Feature
PCT/US2016/056851	An adjuvant	A stable self emulsifiable alkylated oil based adjuvant with pH buffer capabilities,
US15/496776	Water-in-oil polyacrylamide-based microemulsions and related methods	A water-in-oil microemulsion, including a polyacrylamide, a fatty acid, a surfactant, an oil continuous phase, and an aqueous discontinuous phase in the oil continuous phase.
US15/435849	Lactones as solvents in agrochemical formulations	The present invention relates to the use of a water soluble lactone-derivative as a solvent in agrochemical formulations, as well as to such formulations per se in both concentrated and dilute form, and methods of making such formulations

Group 3 – Drift Modifiers

Scope: Patents related to drift reduction systems and/or new or novel chemistries for this use

No. of patents in group: 34

Major trends: surfactants not typically used (e.g.. foaming agents, large MW alkoxylates and low HLB), solvents, encapsulated polymers and inorganic salts (e.g. potassium sulfate and phosphates)

Publication No.	Title	Novel Feature
WO2018005340A1	Spray drift reduction	Spray drift reductants for use in spray drift reduction The reductants are selected from alkoxylated polyol or polyamine which is optionally acyl terminated, and the formulation may optionally comprise non-ionic alkoxylate.
CA2887364A1	Alkylbenzene sulfonate surfactants for controlling herbicide spray drift	Spray drift is reduced by incorporating one or more alkylbenzene sulfonate surfactants.
WO2014040120A1	Effervescent tablet for spray drift reduction and method of use	A liquid spray additive composition comprising: 5 to 15 wt.% of spray drift retardant incorporating a effervescent couple comprising 15 to 30 wt. % acid, and 30 to 50 wt. % alkali, wherein the composition is in the form of a tablet.
US20170223952A1	Use of etherified lactate esters for reducing the drift during the application of plant-treatment agents	The invention relates to the use of one or more etherified lactate esters of formula (I) for reducing the drift during the application of plant-treatment agents

Group 4 – Vapor Reduction adjuvants

Scope: Patents related to lower volatility formulations. Specific patent examples below are for adjuvant systems specifically

No. of patents in group: 15

Major trends: Most systems are pesticide specific. Use of emulsion technology seems to be driving developments. Some use of polymers but limited to polysaccharides and some water soluble high molecular weight water soluble synthetic polymers

Publication No.	Title	Novel Feature
US15/146395	Stable emulsion formulations of encapsulated volatile compounds	A stable water-in-oil-in-water double emulsion. The double emulsion composition disclosed may contain molecular complex of volatile compounds for example 1-methylcyclopropene (1-MCP)
CA2883429	Compositions and methods for double encapsulation of a volatile compound	Compositions comprising double encapsulated particles having a waxy coating and being imbedded in a resin matrix. Such double encapsulated particles are further coated with Pickering particles and suspended in oil.

Group 5 – General Adjuvants

Scope: General Patents related to tank mix adjuvants

No. of patents in group: 64

Major trends: Use of biological based materials, polysaccharides, polymers and non-traditional surfactants

Publication No.	Title	Novel Feature
US20180368398A1	Efficacy-enhancing agent composition for agrochemicals	An invention I for agrochemicals, including water and one or more cellulose derivatives. a sulfate, a phosphate, a nitrate, a carbohydrate and glycerin, one or more surfactants selected from an alkylbenzene and an alkyl dimethylamine oxide
AU2017229645A1	Liposomal formulations and methods of using same in agriculture	The present disclosure provides a formulation comprising an agriculturally acceptable carrier and liposomes formed from phospholipids.
WO2016195978A1	Surfactant blend for increased compatibility in agrochemical formulations	A compatibility agent system comprising an alkyl alkoxy sulfate; an alkyl aryl sulfonate; a dialkyl sulfosuccinate; a diaryl sulfosuccinate; a polystyrylphenol alkoxy sulfate; a poly(styrene oxide) alkoxy sulfate; an alkyl alkoxy phosphate; and (ii) a non-aromatic solvent.
WO2016186529A1	Adjuvant for agrochemicals	An adjuvant that contains a mixture of paraffin oil with plant oil and/or alkyl ester of fatty acids of plant origin and an emulsifying-wetting component which is a multicomponent mixture of surfactants.

Group 6 – Lecithin containing adjuvants

Scope: Patents related to tank mix adjuvants that contain lecithin

No. of patents in group: 6

Major trends: Incorporation of lecithin or lecithin derivatives such as ethoxylated lecithin. All referenced lecithin formulations appear to contain some oil material

Publication No.	Title	Novel Feature
PCT/US2017/031208	Agricultural adjuvant	Agricultural adjuvant comprising amine surfactant, oil, lecithin, emulsifier, and water, wherein, when combined with a herbicide composition that contains auxin herbicide, the volatility of the auxin herbicide does not increase.
AU2013230085	Microemulsions and uses thereof as delivery systems	Microemulsion compositions include a blend of lecithin and a co-surfactant, and an acidifier. The compositions may further include salts of the acidifier, such as lactic acid or sodium lactate. The microemulsion may be used to produce a multi-functional agricultural adjuvant that is able to deliver an active ingredient such as a pesticide control, pH improve, wetting, and penetration of an agricultural chemical, control droplet size, function at extreme pH or salt concentration and/or other provide another functional benefit.

Group 7 – Water Conditioning adjuvants

Scope: Patents incorporating a water conditioning agent. Patents describing a water conditioning agent NOT containing ammonia

No. of patents in group: 10

Major trends: New chemistry, use of polysaccharides and polymers

Publication No.	Title	Novel Feature
WO2018145051A1	Ams-free adjuvants for water conditioning and agricultural formulations	Agricultural formulations containing one or more water conditioning components, in particular, quaternary ammonium salts of chelating agents or polyprotic acids, as well as, optionally, one or more polymers, in particular, polysaccharides, and optionally one or more surfactants, which are capable of being solubilized or homogenously dispersed in an aqueous or semi-aqueous pesticide/herbicide composition.
WO2018106540A1	Water-soluble encapsulated clarifying agent	The present invention is directed to compositions and methods of encapsulating a coagulant or flocculant in a water soluble polymer encapsulant.
EP3203839A1	Alkanolamine sulfate water conditioners	The water conditioning agent is an alkanolammonium sulfate. Embodiments of the present disclosure further include a method of conditioning water while maintaining comparable volatility in an agricultural formulation by adding at least one water conditioning agent to an agriculturally active ingredient, wherein the water conditioning agent comprises at least one alkanolamine sulfate.
WO2016168299A1	Liquid ammonium-free adjuvants and agricultural compositions for drift reduction and water conditioning	Liquid adjuvant compositions, which comprise a polysaccharide, alkali metal bicarbonate, potassium sulfate and a dispersant, as well as methods of making and applications thereof.

Group 9 – RNAi adjuvants or systems

Scope: Patents related to RNAi in formulations

No. of patents in group: 37

Major trends: **Very few patents were formulation patents. Most activity to date is in the RNAi itself and not the application of the same**

Publication No.	Title	Novel Feature
WO2016196738A1	Compositions and methods for delivery of a polynucleotide into a plant	Compositions and methods for delivering a polynucleotide from the exterior surface of a plant or plant part into the interior of a plant cell. More specifically, compositions comprising at least one polynucleotide and at least one agent that is able to disrupt at least one barrier of the plant or plant part.
US20180360030A1	Methods and compositions for delivery of polynucleotides	Compositions and methods for delivery of a polynucleotide to an organism. More specifically, a mixture of a polynucleotide and a cationic polysaccharide, and methods of providing such compositions to an organism
WO2016201523A1	Composition	Composition for delivery of double stranded RNA to an insect having a basic pH within its alimentary canal, wherein the composition comprises double stranded RNA adsorbed onto a clay complex, and wherein the clay complex is configured to release the double stranded RNA at the basic pH

Group 10 - Surfactants for adjuvants

Scope: Patents related to surfactants where adjuvant applications or tank mix additive is mentioned

No. of patents in group: 30

Major trends: Many surfactant patents have been filed but most are targeted as adjuvants for in-can formulations. Specific adjuvant testing is not present in most cases. All patents and applications are targeting lower toxicity and try to use natural components where possible

Publication No.	Title	Novel Feature
US20160249604A1	Use of sophorolipids and derivatives thereof in combination with pesticides as adjuvant/additive for plant protection and the industrial non-crop field	Biological substance which is toxicologically unobjectionable, are not environmentally hazardous according to EC Directive 1907/2006, greatly lower the surface tension of water, are water-soluble or dispersible, and can be used as a tank mix additive
AU2016371249A1	**Dendrimer** and formulations thereof	The present invention relates to formulations comprising pesticides with improved characteristics such as reduced crystallization, compatibility with hard water and an extended shelf life at low temperatures.
US20150342183A1	Nitrogen containing surfactants for agricultural use	The surfactants comprise nitrogen containing surfactants with N+—CH2COO−, N+—CH2COOCH3, N—CH2COO−M+, N—CH2CH2COO−M+, and/or amine oxide functionalities which enhance the pesticide activity.

Group 14 - Polymers

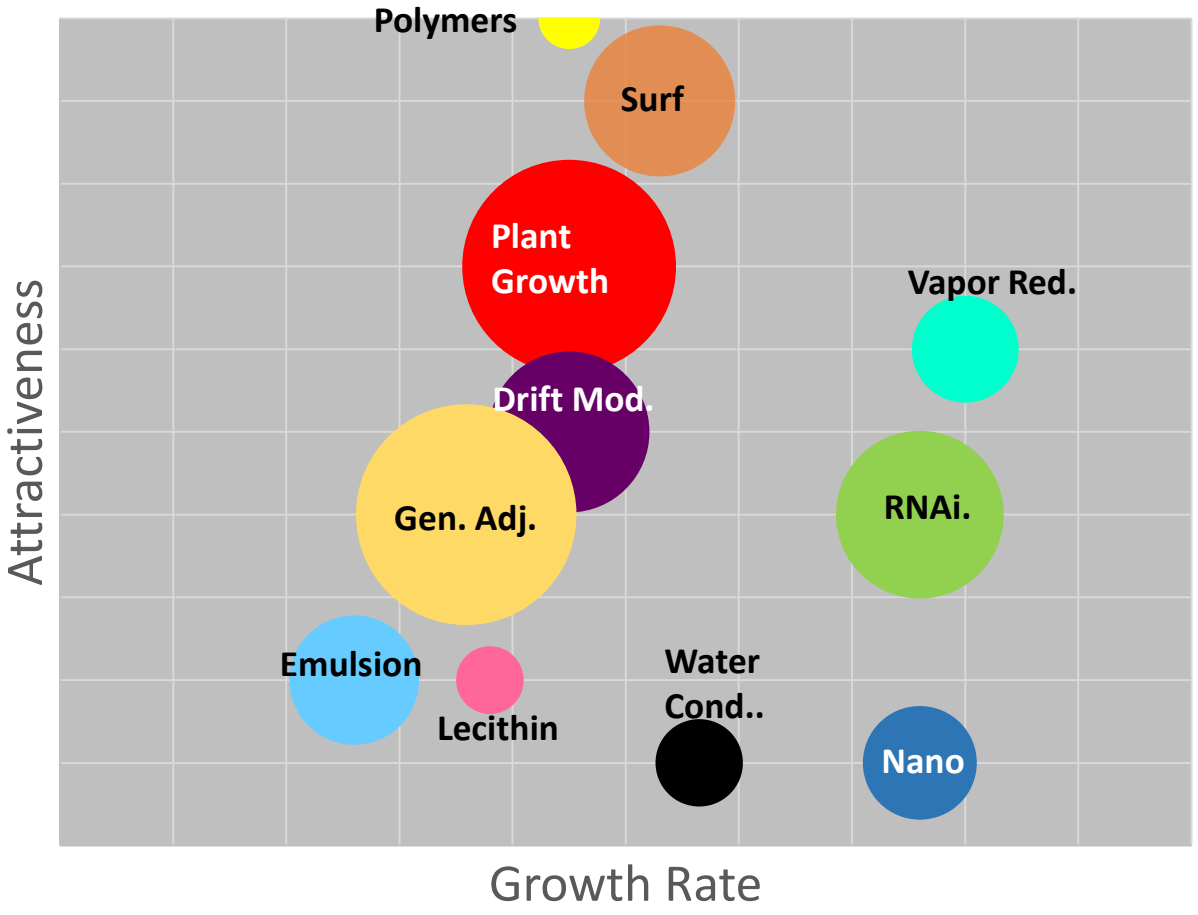
Scope: Patents related to the use of polymeric materials for adjuvant effects or viscosity modification

No. of patents in group: 7

Major trends: viscosity modification, drift modification and thickening polymers

Publication No.	Title	Novel Feature
US20160375139A1	Composition comprising a polymer and a bioactive agent and method of preparing thereof	Compositions comprising at least one amino acid based polymer or polymer blend, at least one bioactive agent, and optionally at least one filler.
WO2018122122A1	Thickened organic liquid compositions with polymeric rheology modifiers	Disclosed are thickened organic liquid compositions comprising an organic liquid and a polymeric rheology modifier wherein the polymeric rheology modifier is obtainable by co- polymerizing at least two of a bicyclic (meth) acrylate ester, an alkyl (meth) acrylate, and an aromatic vinyl monomer.
WO2018033717A1	Method for applying a treatment agent to a substrate	A method for applying a treatment agent to a substrate, wherein the treatment agent is bound to a solid polymeric particle at a first pH, and wherein the substrate is contacted with the solid polymeric treatment particles under conditions such that the treatment agent is released from the solid polymeric treatment particles.

Marketing Impact

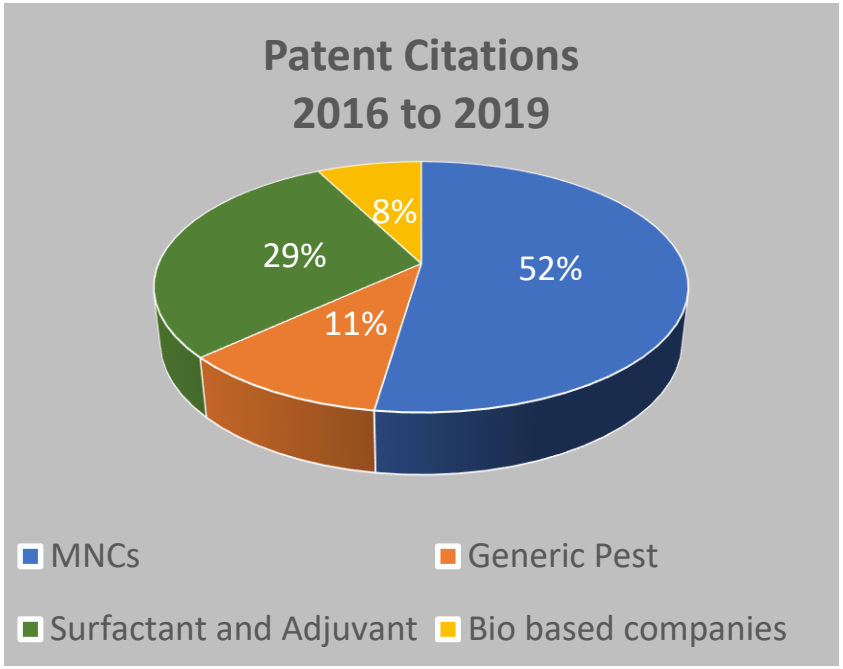


- Attractiveness defined as: Market Size, No. of competitors and novelty of technology
- Growth rate determined on arbitrary scale of 1-5 where 1 is low growth rate and 5 is high growth rate
- Size of the bubble indicates No. of patents found in study

General Observations

The technology in the ADJUVANT space continues to advance creating exciting market opportunities. Innovation is key……

- Most adjuvant patents are being filed (52%) by MNCs in the last three years. Initial data analysis going back 10 years showed 65% of the adjuvant patents were filed by surfactant and adjuvant companies. A major shift is taking place in the technology.
- The growth in bio related adjuvants in the last three years is significant and expected to continue to grow.
- Incorporation of multipurpose, multifunctional adjuvants is a trend that is continuing. Not necessarily new to the industry but the rate of change is important
- Polymers, macromolecules (lecithin, liposomes and encapsulates) and polysaccharides show significant use increases over the last few years
- Nanotechnology although present is not a significant source of new developments (YET) as EPA wrestles with the environmental effects.



Thank you for you attention !

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