A brief history of aluminum stearate as a component of paint

The earliest and simplest oil paints were mixtures of pigments and drying oils. Eventually driers, resins, fillers, sometimes adulterants and suspension aids were also added. Aluminum stearate was one of the components introduced in the 20th century. The gelling of oil solutions by aluminum soaps was known since at least the late 19th century but the use of aluminum stearate to alter the properties of paint did not come into use until much later. Church in 1901 mentions the use of "linoleate or oleate of alumina" to prevent the "subsidence" of vermilion in tubes (Church 1901), a comment not found in the 1890 edition (Church 1890). No further mention is made of this or similar materials until decades later even in Gardner's test protocols of 1911, the first of a series of books which would become the industry standard for paint analysis (Gardner 1911).

Aluminum stearate has been used to help suspend pigments in oil to prevent separation, to reduce the amount of oil needed to wet the pigment, and/or to increase the body of the paint by forming a gel with the oil thereby requiring less pigment.

Research into the use of aluminum and zinc stearates as aids to grinding pigments and preventing settling or separation of pigment from vehicle (medium) resulted in a patent application in 1920 and issue of U.S. patent #1,421,625 on July 23, 1922 to Clarence A. Ward. The aluminum stearate was added in a range of from 1 to 5% by weight. U.S. patent #1,428,273 describing a variation of this procedure but using unsaturated mineral oils as a vehicle and aluminum soaps (stearate, palmitate etc.) to "jellify" the oil was issued on September 5, 1922 to W. A. Collings.

A 1923 commercial painters manual, however, does not list these soaps (Kelly 1923), but by 1927 the fourth edition of Gardner's paint testing manual states: "Aluminum stearate has been used in considerable quantities during recent years, in the paint and varnish industries." (Gardner 1927, p. 664). A British test manual of 1927, however, fails to mention aluminum stearate or its class of materials (Fox and Bowles 1927). So at least by the early to mid 1920's aluminum stearate was available for commercial use and by implication use in artists' paints.

In regard to the wetting of pigments, the small amounts of free fatty acids normally present in pressed oils helped form soaps at the pigment interface, aided dispersion, and improved settling characteristics. Alkali refined linseed with its low free acid content created settling problems which were mediated by pigments precoated with metal soaps.

When aluminum stearate was first introduced to artists' paints specifically is not known, but it is directly mentioned in a 1942 painting materials review (Gettens and Stout 1942) and in a paper by Levison in 1949 when he wrote "... the use of aluminum stearate, customary for several decades, was openly declared, .." (Levison 1949 p. 826). He also notes that this soap can be added in quantities up to 2% of the grind without perceptible dilution of pigment color.

Unlike calcium and zinc stearates that are available as 100% pure salts, the aluminum stearate as used in commerce is a non-stoichiometric compound. The trivalent aluminum may be united with one or two stearate anions with the balance of the charge being neutralized by hydroxyl anions (Elliott 1946; Pilpel 1971). Aqueous systems for the preparation or use of disalts seems to lead to a range of products containing varying amounts of stearate, hydroxyl, and water units (Pilpel 1963). Anhydrous systems are needed to prepare stearates higher than the di-salt. Commercial preparations of aluminum stearate may also contain anywhere from 2 to 7% by weight free stearic acid (Pilpel 1971; Witco 1999). Analysis by weight of two commercial specimens by the author showed free stearic acid as 2 and 3% respectively. Early preparations may also contain significant amounts of palmitate (from palmitic acid) since the commercial stearic acid used in the preparation of metal soaps was often only 90% pure. Other fatty acids (palmitic, oleic, linoleic etc.) were also present as impurities (Pilpel 1971).

Aluminum stearate dissolves in vegetable oils on heating and if a high enough concentration of the soap is used, gelling occurs on cooling. In the usual practice of making paints, the aluminum stearate is ground with the pigment before the bulk of the oil is added.

In a series of experiments Gardner tested the effects of metal soaps on pigments. Aluminum stearate was found to coat the surface of pigment particles and helped prevent settling as well as reducing the amount of oil needed to wet the pigment. The amount of aluminum stearate needed to coat pigments varied on a weight basis, but a solution of 2% by weight (wt stearate/wt oil) aluminum stearate was more effective than 0.5% or 4% solutions in altering the surface (Gardner 1930). The soaps coat the surface of the pigments and by steric effects or electrical charge mechanisms keep the particles from aggregating (Pilpel 1966). This keeps the pigments in suspension.

With increasing amounts of aluminum stearate the oil pigment mixture becomes viscous, and by using an appropriate amount of aluminum stearate the paint can gel at a lower pigment concentration (Mayer 1965). This can be used to create a "cheaper" paint since a smaller amount of a costly pigment needs to be used. A significant advantage of using stearates is that the oil and pigment do not separate greatly over long periods of time in the paint tube.

At present the manufacturers of artists' paints often use aluminum stearate in their formulations without listing it as a component.

References

Aluminum stearate has a molecular weight of 876.0. Aluminum stearate is used in cosmetics, often as an emulsifier. The aluminum stearate comes from stearic acid. It is used in the formulation of many cosmetic products, including cleansers, lotions, and lipsticks. It is also used in the manufacture of paints and varnishes.

Normal aluminum requires a lot of preparation, such as zinc oxide as a primer before you can paint it. Anodized surfaces are inert and as long as they are not waxed/polished, etc., they will remain slightly porous. Anodization is the BEST surface preparation before painting. Nothing else needs to be done. Don't expect to be able to get the paint off again though. (F) Metallic stearates are compounds of long-chain fatty acids with metals of different valencies. The most important metallic stearates, in terms of quantity, are the metallic stearates of aluminum, calcium, magnesium, and zinc. The main advantage is their manifold range of use. Among the interesting properties of metallic stearates, the most important are:

- Lubricating properties
- Separating properties
- Water repellence
- Gelling capacity
- Stabilizing effect
- Foam inhibition

Contrary to most other lubricants and release agents, metallic stearates are characterized by their relatively high melting point.

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