containing the same, or that may create unwanted health, safety or environmental issues. It is further desired that such methods for making APs enables one to specially engineer AP particles and compositions having certain desired characteristics and/or performance properties not otherwise obtainable using conventional methods of making, to enable the use of such formed APs in a greater variety of end-use applications. Further, it is desired that such methods enable forming APs in a manner that is relatively more cost effective and/or efficient as compared to the conventional methods of forming APs.

SUMMARY ~~OF THE INVENTION~~

In a first aspect of the present disclosure, there is provided a method for making aluminum phosphate compositions comprising the steps of:

combining aluminum hydroxide with water to form a slurry;

adding the aluminum hydroxide slurry to phosphoric acid to form a mixture; and

reacting the mixture for a period of time to form a reaction product comprising aluminum phosphate condensate in the reaction product.

In a second aspect of the present disclosure, there is provided a chemical composition comprising a binding polymer and the aluminum phosphate prepared according to the first aspect.

In a third aspect of the present disclosure, there is provided a method for making aluminum phosphate compositions comprising the steps of:

combining aluminum hydroxide with water to form a slurry;

adding the aluminum hydroxide slurry to phosphoric acid to form an acidic aluminum phosphate solution;

combining the acidic aluminum phosphate solution with aluminum hydroxide slurry to form a mixture; and

reacting the mixture for a period of time to form a reaction product comprising aluminum phosphate condensate in solution.

In a fourth aspect of the present disclosure, there is provided a chemical composition comprising a binding polymer and the aluminum phosphate prepared according to the third aspect.

In a fifth aspect of the present disclosure, there is provided a method for making aluminum phosphate comprising the steps of:

combining aluminum hydroxide with water to form a slurry;

adding the aluminum hydroxide slurry to phosphoric acid to form a mixture; and

reacting the mixture for a period of time to form a reaction product comprising aluminum phosphate condensate in solution, wherein during the step of reacting the volume of the mixture is variable.

In a first embodiment of the fifth aspect, wherein during the step of reacting, water from the mixture is evaporated, and water is added to the reaction product.

In a second embodiment of the fifth aspect, wherein during the step of reacting, water from the mixture is evaporated, and water is added to the reaction product, and wherein during the step of reacting, aluminum phosphate particles are formed and further aluminum phosphate is disposed onto the already formed aluminum phosphate particles.

In a sixth aspect of the present disclosure, there is provided aluminum phosphate, formed according to the method of the second embodiment of the fifth aspect, comprising aluminum phosphate particles that are coated with further aluminum phosphate particles.

In a seventh aspect of the present disclosure, there is provided a chemical composition comprising a binding polymer and the amorphous aluminum phosphate prepared according to the first embodiment of the fifth aspect.

In an eighth aspect of the present disclosure, there is provided a method for making aluminum phosphate compositions comprising the steps of
combining aluminum hydroxide with water to form a slurry,
adding to the slurry phosphoric acid to form a mixture;
reacting the mixture at elevated temperature to form a reaction product; and
separating out an aluminum phosphate condensate from the reaction product.

In a ninth aspect of the present disclosure, there is provided a coating composition comprising;
an aluminum phosphate pigment having a surface area of less than about 20 $m^2/g$;
a pigment material different from the aluminum phosphate; and
a binding polymer, wherein the aluminum phosphate and pigment material are dispersed within the binding polymer.

APs as disclosed herein are made according to a number of different binary condensation techniques. In one example embodiment, APs can be made by a base-to-acid route wherein aluminum hydroxide slurry is added to phosphoric acid in a controlled fashion to form a mixture that undergoes reaction at an elevated temperature

to produce a reaction product comprising aluminum phosphate condensate in the reaction product.

In another example embodiment, APs can be made by an acid-to-base route wherein phosphoric acid is added in a controlled fashion to aluminum hydroxide slurry to form a mixture, and the mixture undergoes reaction at elevated temperature to produce a reaction product comprising an aluminum phosphate condensate.

In an alternative acid-to-base route, a first portion of the aluminum hydroxide slurry (e.g., comprising about 1/3 of the total amount of the aluminum hydroxide) is combined with phosphoric acid to form an acidic aluminum phosphate solution, and then adding the so-formed acidic aluminum phosphate solution with a second portion of the aluminum hydroxide slurry (e.g., comprising the remaining 2/3rds of the total amount of the aluminum hydroxide) form a mixture. The mixture undergoes reaction at an elevated temperature to form a reaction product comprising aluminum phosphate condensate in solution.

The APs made according to the methods disclosed above can be reacted under conditions of constant volume or under conditions of variable volume. When reacted under conditions of variable volume, moisture is allowed to escape during reaction and water is added at certain intervals to produce in-situ AP particle layering, e.g., wherein