CLAIMS

1. Phosphate salt in solid form of formula $M_n(HPO_4)y.zH_20$ in which M is Na, K, NH_4, n = 2, and y = 1 ; or M is Ca, n = 1, y = 1 ; or M is Al or Fe, n =2, y = 3; and in which z is 0, 1 or 2; said phosphate salt has a phosphate content expressed as a P_2O_5 content of between 30 and 50% by weight of the phosphate salt, preferably 36 to 45% by weight, characterised in that the cadmium content in said phosphate salt is less than 0.40 ppm, preferably less than 0.30 ppm, preferably less than 0.20 ppm, in particular less than 0.10 ppm.

2. Phosphate salt according to claim 1 characterised in that the Ra^{226} content is less than 100 Bq/kg, preferably less than 50 Bq/kg, preferably less than 10 Bq/kg, in particular less than 5 Bq/kg.

3. Phosphate salt according to claim 1 or 2 characterised in that the magnesium content is less than or equal to 20 ppm.

4. Phosphate salt according to any of the previous claims characterized in that the uranium content in said phosphate salt is less than 1500 Bq/kg, preferably less than 1000 Bq/kg, in particular less than 800 Bq/kg, the uranium content being determined by the respective contents of U^{234}, U^{235} and U^{238}.

5. Phosphate salt according to any of the previous claims characterised in that the Pb^{210} content in said phosphate salt is less than 1500 Bq/kg, preferably less than 1000 Bq/kg, preferably less than 800 Bq/kg, in particular less than 500 Bq/kg.

6. Phosphate salt according to any of the previous claims characterised in that the content of polonium Po^{210} in said phosphate salt is less than 300 Bq/kg, preferably less than 200 Bq/kg, preferably less than 150 Bq/kg.

7. Phosphate salt according to any one of the previous claims characterised in that the phosphate salt is a calcium phosphate salt preferably having a calcium content of between 15 and 30% by weight.

8. Phosphate salt according to any one of the previous claims characterised in that it is in the form of solid particle aggregate having a diameter of between 500 µm and 5 mm, preferably between 500 µm and 3 mm, preferably between 1 mm and 2 mm.

9. Phosphate salt according to any one of claims 1 to 7 characterised in that it is in the form of solid particle aggregates having a diameter less than 500 μm, preferably a diameter between 50 μm and 500 μm, preferably between 100 μm and 200 μm.

10. Phosphate salt according to any one of the previous claims characterised in that it also has one or more of the following contents of metallic impurities: the strontium content is less than 280 ppm or the nickel content is less than 3 ppm or the thallium content is less than 5 ppm or the lead content is less than 3 ppm or a manganese content of less than 15 ppm or a molybdenum content of less than 3 ppm.

11. Phosphate salt according to any one of the previous claims characterised in that it is produced from a phosphate source selected from a group consisting of the phosphate ore or secondary phosphate sources such as ash or any other raw material containing more than 10% of phosphate expressed as content of P_2O_5 by weight in the phosphate source.

12. Use of a phosphate salt according to any of the previous claims as an ingredient in a composition intended for agricultural use, in a food composition, or as a starting material for the preparation of phosphoric acid, monocalcium phosphate, mono-dicalcium phosphate, single superphosphate or triple superphosphate, ammonium phosphate salts, potassium phosphate salts, or fertilizer compounds comprising a phosphate group.

13. Method for the preparation of a phosphate salt according to any one of the previous claims 1 to 12 comprising the following steps:

a) a phosphate source digestion using a first aqueous solution of hydrochloric acid, with formation of an attack liquor consisting of an aqueous phase comprising phosphate ions and chloride ions in solution, and a first insoluble solid phase containing impurities,

b)a first separation between the aqueous phase comprising phosphate and chloride ions in solution and the first insoluble solid phase containing impurities,

c) a neutralisation of said aqueous phase comprising phosphate ions and chloride ions in solution at a pH sufficient to form an aqueous medium comprising chloride ions and to precipitate the phosphate ions in the form of said phosphate salt,

d) a second separation between said aqueous medium comprising chloride ions and said phosphate salt,

characterized in that steps a) and b) are performed at a temperature between 50°C and 70°C for a duration less than two hours and in that said first aqueous solution of hydrochloric acid has an HCl concentration less than or equal to 15% by weight.

14. Method according to the previous claim characterised in that step a) lasts for less than one hour, preferably less than 30 minutes, preferably between 5 minutes and 20 minutes.

15. Method according to any one of claims 13 or 14 characterized in that the neutralisation carried out in step c) takes less than four hours, preferably less than two hours, preferably less than one hour.

16. Method according to any one of claims 13 to 15 characterised in that said phosphate source may have a magnesium content higher than 1.5% by weight based on the total weight of the phosphate source.

17. Method according to any one of claims 13 to 16 characterised in that said phosphate salt contains less than 5% by weight of the magnesium originally contained in said phosphate source.

18. Method according to any one of claims 13 to 17 characterised in that said phosphate source of step a) is selected from a group consisting of the phosphate ore or secondary phosphate sources such as ash or any other raw material containing more than 10% of phosphate expressed as content of P_2O_5 by weight in the phosphate source.

19. Method according to any one of claims 13 to 18 characterized in that said first aqueous solution of hydrochloric acid has a concentration of HCl that is 8 to 13% by weight, preferably 12% by weight.

20. Method according to any one of claims 13 to 19 characterised in that in the attack liquor, the molar ratio between HCl and Ca is between 1.2 and 2.6, preferably between 1.6 and 2.4.

21. Method according to any one of claims 13 to 20 characterised in that said neutralisation in step c) is performed in the presence of calcium carbonate, calcium hydroxide, calcium oxide or one or more calcium salts, sodium salts or ammonium salts.

22. Method according to any one of claims 13 to 21 characterised in that said neutralisation in step c) is performed in the presence of calcium carbonate, calcium hydroxide, calcium oxide or a calcium salt soluble in water; said precipitated phosphate salt

is a calcium phosphate salt and said aqueous medium contains chloride ions and calcium ions.

23. Method according to any one of claims 13 to 22 characterised in that in step c), the pH is below 5, preferably between 2.0 and 5.0, preferably between 2.5 and 4.0, in particular between 2.5 and 3.0.

24. Method according to any one of claims 13 to 23 characterised in that said neutralisation in step c) is performed in the presence of calcium carbonate, calcium hydroxide, calcium oxide or a calcium salt soluble in water; said precipitated phosphate salt is a calcium phosphate salt and said aqueous medium is a calcium chloride solution having a calcium chloride content between 8 and 20% by weight of the solution, preferably between 12 and 20% by weight, preferably about 15% by weight.

25. Method according to any one of claims 13 to 24 characterized in that a basic compound is added to said aqueous medium comprising chloride ions obtained in step d) to form a purified aqueous phase comprising chloride ions and of pH between 8 and 12, preferably between 9 and 10, and a solid phase comprising impurities.

26. Method according to any one of claims 13 to 25 characterised in that said neutralisation in step c) is performed in the presence of calcium carbonate, calcium hydroxide, calcium oxide or a calcium salt soluble in water; said precipitated phosphate salt is a calcium phosphate salt and said aqueous medium contains chloride ions and calcium ions forming a solution of calcium chloride; and in that a basic compound selected from calcium hydroxide, calcium oxide and calcium salts, sodium salts or potassium salts or ammonium salt is added to said purified calcium chloride solution having a pH between 8 and 12, and a solid phase comprising impurities in the form of magnesium salts.

27. Method according to any one of the previous claims 13 to 26 characterized in that it further comprises the following steps:

e)an attack of all or part of said phosphate salt obtained in step d) using an aqueous solution of strong acid to form a suspension of first phosphoric acid in solution and a second solid phase,

f)a third separation between the first phosphoric acid and said second solid phase.

28. Method according to claim 27 characterized in that in step e) the molar ratio of the aqueous solution of strong acid and said phosphate salt obtained in step d) is between 0.6 and 1.6.

29. Method according to any one of claims 27 or 28 characterized in that the aqueous solution of strong acid used in step e) is an aqueous solution of sulphuric acid and the second solid phase formed in step e) comprises calcium sulphate hemihydrate, calcium sulphate dihydrate or a mixture thereof.

30. Method according to any one of claims 27 to 29 characterized in that the second solid phase obtained in step f) and comprising calcium sulphate hemihydrate, calcium sulphate dihydrate or a mixture thereof, is mixed with an acid solution to form a solid phase comprising calcium sulphate dihydrate and an acidic aqueous phase comprising phosphate ions.

31. Method according to the preceding claim characterized in that the acid solution is a sulphuric acid solution and the second solid phase obtained in step f) is also mixed with said purified aqueous phase according to claim 25 or 26, or with said aqueous medium comprising chloride ions obtained in step d) or with said aqueous medium comprising chloride ions and calcium ions according to claim 24, or their mixtures to form a solid phase comprising calcium sulphate dihydrate and an aqueous phase comprising hydrochloric acid.

32. Method according to claim 30 or 31 characterized in that the aqueous phase containing hydrochloric acid is recycled to form all or part of said first aqueous solution of hydrochloric acid used in step a).

33. Method according to any one of claims 13 to 32 characterised in that it is carried out continuously.

34. Method according to any one of claims 13 to 33 characterized in that step a) is implemented in a co-current reactor comprising 2 to 12 compartments.

35. Method according to any one of claims 13 to 34 characterized in that step c) is implemented in a co-current reactor comprising 2 to 12 compartments.

36. Use of the phosphate salt according to claim 12 characterised in that said phosphate salt is prepared using the method as defined in any one of claims 13 to 35.

37. Use according to claim 12 or 36 characterized in that said composition intended for agriculture is a fertilizer composition that is liquid or soluble in water or said food composition is a composition for animal or livestock feed or human food.

38. Composition comprising a phosphate salt according to any one of claims 1 to 11.

39. Composition according to the preceding claim characterized in that it is a food composition and also comprises a basic food material.

40. Method for preparing the composition according to the preceding claim characterized in that it comprises the following steps:

A)preparation of said phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)mixing of said phosphate salt obtained in A) with a basic food material.

41. Composition according to claim 38 characterized in that it is a composition intended for agricultural use also comprising a potassium source and/or a nitrogen source to preferably form a fertilizer composition, in particular a liquid fertilizer composition, or a composition partially or fully soluble in water.

42. Method for preparing the composition according to the preceding claim characterized in that it comprises the following steps:

A) Preparation of said phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B) mixing of said phosphate salt with a potassium source and/or a nitrogen source;

43. Method of preparation of single superphosphate (SSP) comprising the following steps:

A) preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of sulphuric acid, and optionally phosphoric acid, water, to said phosphate salt obtained in A) to form SSP.

44. Method for preparation of monoammonium phosphate (MAP) or diammonium phosphate (DAP) comprising the following steps:

A)preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of sulphuric acid and ammonia or an ammonium salt to said phosphate salt obtained in A) to form monoammonium phosphate or diammonium phosphate, preferably the sulphuric acid is added prior to the ammonia.

45. Method for preparation of an NPK composition comprising the following steps:

A)preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of sulphuric acid, a nitrogen source or a potassium source, or both, to said phosphate salt obtained in A) to form said NPK composition.

46. Method for preparation of phosphoric acid comprising the following steps:

A) Preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B) Addition of sulphuric acid to said phosphate salt obtained in A) and optionally water to form phosphoric acid; the molar ratio between sulphuric acid and said phosphate salt is between 0.9 and 1.1.

47. Method of preparation of triple superphosphate (TSP) comprising the following steps:

A)preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of phosphoric acid, and optionally sulphuric acid, water, to said phosphate salt obtained in A) to form TSP.

48. Method of preparation of monocalcium phosphate (MCP) comprising the following steps:

A)preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of phosphoric acid to said phosphate salt obtained in A) to form monocalcium phosphate; the weight ratio between phosphoric acid and said phosphate salt is between 0.5 and 0.65.

49. Method of preparation of mono-di-calcium phosphate (MDCP) comprising the following steps:

A)preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B)addition of phosphoric acid to said phosphate salt obtained in A) to form mono-di-calcium phosphate; the weight ratio between phosphoric acid and said phosphate salt is less than 0.5.

50. Method of preparation of potassium phosphate comprising the following steps:

A) Preparation of a phosphate salt according to any one of claims 1 to 11 preferably using the method of any one of claims 13 to 35,

B) addition of a source of potassium to said phosphate salt obtained in A) and optionally an acid to form said potassium phosphate.