

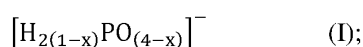
CLAIMS

What is claimed is:

1. A dehydration catalyst consisting essentially of:

a. one or more amorphous phosphate salts consisting essentially of:

- i) one or more monovalent cations, and
- ii) one or more phosphate anions selected from the group represented by empirical formula (I):

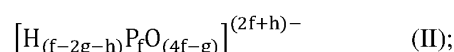


wherein x is any real number equal to or greater than 0 and equal to or less than 1;

wherein said one or more amorphous phosphate salts are neutrally charged;

b. one or more crystalline phosphate salts consisting essentially of:

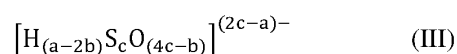
- i) one or more polyvalent cations, and
- ii) one or more phosphate anions selected from the group represented by molecular formula (II):



wherein f is a positive integer; wherein g is a positive integer or zero; wherein h is an integer; wherein (f-2g-h) is equal to or greater than zero; wherein (4f-g) is greater than zero; wherein (2f+h) is greater than zero; wherein (4h/f) is equal to or greater than -2 and equal to or less than 1; wherein said one or more crystalline phosphate salts are neutrally charged; and

c. one or more non-phosphate salts consisting essentially of:

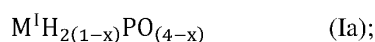
- i) one or more polyvalent cations, and
- ii) one or more non-phosphate anions selected from the group represented by molecular formulae (III) and (IV):



wherein a and b are positive integers or zero; wherein c, d, and e are positive integers; wherein (a-2b) is equal to or greater than zero; wherein (2c-a) is greater than zero; wherein said one or more non-phosphate salts are neutrally charged;

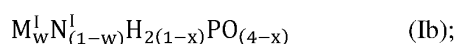
wherein said one or more crystalline phosphate salts and said one or more non-phosphate salts are substantially chemically inert to said one or more amorphous phosphate salts.

2. The dehydration catalyst of claim 1, wherein said one or more monovalent cations are selected from the group consisting of K^+ , Rb^+ , Cs^+ , and mixtures thereof.
3. The dehydration catalyst of claim 1, wherein at least one of said one or more amorphous phosphate salts consists of two or more different monovalent cations selected from the group consisting of K^+ , Rb^+ , and Cs^+ .
4. The dehydration catalyst of claim 1, wherein said one or more amorphous phosphate salts are selected from the group represented by empirical formula (Ia):



wherein M^I is a monovalent cation; wherein x is any real number equal to or greater than 0 and equal to or less than 1.

5. The dehydration catalyst of claim 4, wherein said one or more amorphous phosphate salts are selected from the group consisting of $KH_{2(1-x)}PO_{(4-x)}$, $RbH_{2(1-x)}PO_{(4-x)}$, $CsH_{2(1-x)}PO_{(4-x)}$, any of their hydrated forms, and mixtures thereof; wherein x is any real number equal to or greater than 0 and equal to or less than 1.
6. The dehydration catalyst of claim 5, wherein said one or more amorphous phosphate salts is $KH_{2(1-x)}PO_{(4-x)}$; wherein x is any real number equal to or greater than 0 and equal to or less than 1.
7. The dehydration catalyst of claim 1, wherein said one or more amorphous phosphate salts are selected from the group represented by empirical formula (Ib):



wherein M^I and N^I are two different monovalent cations; wherein x is any real number equal to or greater than 0 and equal to or less than 1; wherein w is any real number greater than 0 and less than 1.

8. The dehydration catalyst of claim 7, wherein said one or more amorphous phosphate salts are selected from the group consisting of $K_w Rb_{(1-w)} H_{2(1-x)} PO_{(4-x)}$, $K_w Cs_{(1-w)} H_{2(1-x)} PO_{(4-x)}$, $Rb_w Cs_{(1-w)} H_{2(1-x)} PO_{(4-x)}$, any of their hydrated forms, and mixtures thereof; wherein x is any real number equal to or greater than 0 and equal to or less than 1; wherein w is any real number greater than 0 and less than 1.

9. The dehydration catalyst of claim 1, wherein said one or more polyvalent cations of said one or more crystalline phosphate salts and wherein said one or more polyvalent cations of said one or more non-phosphate salts are selected from the group consisting of the cations of the metals Be, Mg, Ca, Sr, Ba, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Re, Al, Ga, In, Tl, Si, Ge, Sn, Pb, Sb, Bi, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and mixtures thereof.
10. The dehydration catalyst of claim 1, wherein said one or more polyvalent cations of said one or more crystalline phosphate salts and wherein said one or more polyvalent cations of said one or more non-phosphate salts are selected from the group consisting of the cations of the metals Mg, Ca, Sr, Ba, Y, Mn, Al, Er, and mixtures thereof.
11. The dehydration catalyst of claim 1, wherein said one or more polyvalent cations of said one or more crystalline phosphate salts and wherein said one or more polyvalent cations of said one or more non-phosphate salts are Ba^{2+} .
12. The dehydration catalyst of claim 1, wherein said one or more phosphate anions of said one or more crystalline phosphate salts are selected from the group represented by molecular formulae (IIa) to (IIg), and mixtures thereof:



13. The dehydration catalyst of claim 12, wherein said one or more phosphate anions of said one or more crystalline phosphate salts are selected from the group represented by molecular formulae (IIa), (IIb), and mixtures thereof:



14. The dehydration catalyst of claim 1, wherein said one or more crystalline phosphate salts are selected from the group consisting of BeHPO_4 , MgHPO_4 , CaHPO_4 , SrHPO_4 , BaHPO_4 , BeNH_4PO_4 , $\text{Be}_2\text{P}_2\text{O}_7$, $\text{Mg}_2\text{P}_2\text{O}_7$, $\text{MgK}_2\text{P}_2\text{O}_7$, $\text{Mg}_3\text{K}_2(\text{P}_2\text{O}_7)_2$, $\text{Ca}_2\text{P}_2\text{O}_7$, $\text{CaK}_2\text{P}_2\text{O}_7$, $\text{Ca}_3\text{K}_2(\text{P}_2\text{O}_7)_2$, $\text{Ca}_5\text{K}_2(\text{P}_2\text{O}_7)_3$, $\text{CaRb}_2\text{P}_2\text{O}_7$, $\text{CaCs}_2\text{P}_2\text{O}_7$, CaMgP_2O_7 , $\text{Ca}_3(\text{NH}_4)_2(\text{P}_2\text{O}_7)_2$, $\text{Ca}_5(\text{NH}_4)_2(\text{P}_2\text{O}_7)_3$, $\text{Sr}_2\text{P}_2\text{O}_7$, $\text{SrK}_2\text{P}_2\text{O}_7$, $\text{SrRb}_2\text{P}_2\text{O}_7$, $\text{SrCs}_2\text{P}_2\text{O}_7$, SrMgP_2O_7 , $\text{Ba}_2\text{P}_2\text{O}_7$, BaMgP_2O_7 , BaCaP_2O_7 , $\text{Sc}_4(\text{P}_2\text{O}_7)_3$, ScKP_2O_7 , ScRbP_2O_7 , ScCsP_2O_7 , YKP_2O_7 , YRbP_2O_7 , YCsP_2O_7 , TiP_2O_7 , $\text{Ti}_2\text{Ba}(\text{P}_2\text{O}_7)_2$, ZrP_2O_7 , ZrMgP_2O_7 , HfP_2O_7 , $\text{V}_4(\text{P}_2\text{O}_7)_3$, VKP_2O_7 , VRbP_2O_7 , VCsP_2O_7 , $\text{V}_2\text{Sr}(\text{P}_2\text{O}_7)_2$, $\text{V}_2\text{Ba}(\text{P}_2\text{O}_7)_2$, $\text{Nb}_2\text{Mg}(\text{P}_2\text{O}_7)_2$, $\text{Cr}_4(\text{P}_2\text{O}_7)_3$, CrHP_2O_7 , $\text{CrNH}_4\text{P}_2\text{O}_7$, CrKP_2O_7 , CrRbP_2O_7 , CrCsP_2O_7 , $\text{Cr}_2\text{Mg}(\text{P}_2\text{O}_7)_2$, CrCaP_2O_7 , $\text{Cr}_2\text{Ca}(\text{P}_2\text{O}_7)_2$, $\text{Cr}_2\text{Sr}(\text{P}_2\text{O}_7)_2$, CrBaP_2O_7 , $\text{Cr}_2\text{Ba}(\text{P}_2\text{O}_7)_2$, MoP_2O_7 , MoKP_2O_7 , MoRbP_2O_7 , MoCsP_2O_7 , $\text{Mo}_2\text{Ba}(\text{P}_2\text{O}_7)_2$, $\text{Mn}_2\text{P}_2\text{O}_7$, MnHP_2O_7 , $\text{MnK}_2\text{P}_2\text{O}_7$, MnKP_2O_7 , $2\text{Mn}_2\text{P}_2\text{O}_7 \cdot \text{Mn}_2\text{KP}_3\text{O}_{10}$, $\text{MnRb}_2\text{P}_2\text{O}_7$, MnRbP_2O_7 , MnCsP_2O_7 , MnCaP_2O_7 , MnSrP_2O_7 , MnBaP_2O_7 , ReP_2O_7 , $\text{AlNH}_4\text{P}_2\text{O}_7$, AlKP_2O_7 , AlRbP_2O_7 , $\text{GaNH}_4\text{P}_2\text{O}_7$, GaKP_2O_7 , GaRbP_2O_7 , InKP_2O_7 , InRbP_2O_7 , InCsP_2O_7 , $\text{In}_2\text{Ca}(\text{P}_2\text{O}_7)_2$, $\text{In}_2\text{Sr}(\text{P}_2\text{O}_7)_2$, $\text{In}_2\text{Ba}(\text{P}_2\text{O}_7)_2$, SiP_2O_7 , GeP_2O_7 , SnP_2O_7 , PbP_2O_7 , $\text{Sb}^{\text{V}}\text{Sb}^{\text{III}}(\text{P}_2\text{O}_7)_2$, $\text{Bi}_4(\text{P}_2\text{O}_7)_3$, BiHP_2O_7 , $\text{La}_4(\text{P}_2\text{O}_7)_3$, LaHP_2O_7 , LaKP_2O_7 , CeP_2O_7 , $\text{Gd}_4(\text{P}_2\text{O}_7)_3$, GdKP_2O_7 , GdRbP_2O_7 , GdCsP_2O_7 , TbKP_2O_7 , TbRbP_2O_7 , TbCsP_2O_7 , DyKP_2O_7 , DyRbP_2O_7 , DyCsP_2O_7 , HoKP_2O_7 , HoRbP_2O_7 , HoCsP_2O_7 , ErKP_2O_7 , ErRbP_2O_7 , ErCsP_2O_7 , TmKP_2O_7 , TmRbP_2O_7 , TmCsP_2O_7 , YbHP_2O_7 , YbKP_2O_7 , YbRbP_2O_7 , YbCsP_2O_7 , LuKP_2O_7 , LuRbP_2O_7 , LuCsP_2O_7 , $\text{Be}_2\text{RbP}_3\text{O}_{10}$, $\text{Ca}_2\text{KP}_3\text{O}_{10}$, $\text{Ca}_2\text{RbP}_3\text{O}_{10}$, $\text{Ca}_2\text{CsP}_3\text{O}_{10}$, $\text{Sr}_2\text{KP}_3\text{O}_{10}$, $\text{Sr}_2\text{RbP}_3\text{O}_{10}$, $\text{Sr}_2\text{CsP}_3\text{O}_{10}$, $\text{Ba}_2\text{KP}_3\text{O}_{10}$, $\text{Ba}_2\text{RbP}_3\text{O}_{10}$, $\text{Ba}_2\text{CsP}_3\text{O}_{10}$, $\text{Y}_5(\text{P}_3\text{O}_{10})_3$, $\text{VCsP}_3\text{O}_{10}$, $\text{CrCs}_2\text{P}_3\text{O}_{10}$, $\text{Cr}_3\text{K}(\text{P}_3\text{O}_{10})_2$, $\text{Cr}_3\text{Rb}(\text{P}_3\text{O}_{10})_2$, $\text{Cr}_3\text{Cs}(\text{P}_3\text{O}_{10})_2$, $\text{MnCs}_2\text{P}_3\text{O}_{10}$, $\text{AlCs}_2\text{P}_3\text{O}_{10}$, $\text{Al}_3\text{Cs}(\text{P}_3\text{O}_{10})_2$, $\text{GaCs}_2\text{P}_3\text{O}_{10}$, $\text{In}_5(\text{P}_3\text{O}_{10})_3$, $\text{La}_5(\text{P}_3\text{O}_{10})_3$, $\text{Pr}_5(\text{P}_3\text{O}_{10})_3$, $\text{Nd}_5(\text{P}_3\text{O}_{10})_3$, $\text{Sm}_5(\text{P}_3\text{O}_{10})_3$, $\text{Gd}_5(\text{P}_3\text{O}_{10})_3$, $\text{Er}_5(\text{P}_3\text{O}_{10})_3$, $\text{Yb}_5(\text{P}_3\text{O}_{10})_3$, $\text{Ca}_3\text{P}_4\text{O}_{13}$, $\text{Sr}_3\text{P}_4\text{O}_{13}$, $\text{Ba}_3\text{P}_4\text{O}_{13}$, $\text{Ba}_2\text{MgP}_4\text{O}_{13}$, $\text{Y}_2\text{P}_4\text{O}_{13}$, $\text{Cr}_2\text{P}_4\text{O}_{13}$, $\text{Mn}_2\text{P}_4\text{O}_{13}$, $\text{Gd}_2\text{P}_4\text{O}_{13}$, $\text{Pb}_3\text{P}_4\text{O}_{13}$, $\text{Bi}_2\text{P}_4\text{O}_{13}$, $\text{La}_2\text{P}_4\text{O}_{13}$, any of their hydrated forms, and mixtures thereof.
15. The dehydration catalyst of claim 14, wherein said one or more crystalline phosphate salts are selected from the group consisting of MgHPO_4 , CaHPO_4 , SrHPO_4 , BaHPO_4 , $\text{Mg}_2\text{P}_2\text{O}_7$, $\text{Ca}_2\text{P}_2\text{O}_7$, $\text{Sr}_2\text{P}_2\text{O}_7$, $\text{Ba}_2\text{P}_2\text{O}_7$, YKP_2O_7 , $\text{Mn}_2\text{P}_2\text{O}_7$, MnKP_2O_7 , AlKP_2O_7 , ErKP_2O_7 , $\text{Ca}_3\text{P}_4\text{O}_{13}$, $\text{Sr}_3\text{P}_4\text{O}_{13}$, $\text{Ba}_3\text{P}_4\text{O}_{13}$, any of their hydrated forms, and mixtures thereof.