CLAIMS

1. A pre-filled syringe comprising a barrel and a plunger, the barrel having an outlet, the barrel containing a pharmaceutically acceptable solution having a non-physiological pH, wherein the syringe further comprises an ion exchange material provided such that the pharmaceutically acceptable solution, when contained within the barrel, does not contact the ion exchange material, and wherein the ion exchange material is provided along an ejection path from the syringe, allowing the pharmaceutically acceptable solution to contact the ion exchange material before being ejected from the syringe, wherein the ion exchange material is adapted to, upon contact with the pharmaceutically acceptable solution, adjust the pH of the pharmaceutically acceptable solution from a first, non-physiological pH to a second pH, wherein the first, non-physiological pH is in the range of 3-6.6 and/or the second pH is in the range of 6.6-8.0, wherein the second pH is higher than the first non-physiological pH, wherein the ion-exchange material comprises a solid porous material, wherein the solid porous material comprises at least one material selected from the list consisting of a zeolite material, a polystyrene material or a mesoporous silica, and wherein the pharmaceutically acceptable solution comprises a drug and an acidic buffer solution, wherein the ion exchange material is loaded with positive ions selected from Na^+ and/or Ca^{2+}.

2. The pre-filled syringe according to claim 1, wherein the second pH is in the range of 7.0-8.0.

3. The pre-filled syringe according to claim 2, wherein the second pH is in the range of 7.1-8.0.

4. The pre-filled syringe according to any one of claims 1 to 3, wherein the pre-filled syringe comprises a separator arranged at a position along an ejection path from the barrel, and wherein the pharmaceutically acceptable solution is present upstream of said separator along said ejection path, and the ion exchange material is provided downstream of said separator along

said ejection path, and the separator is adapted to in a first state prevent the pharmaceutically acceptable solution from contacting the ion exchange material, and adapted to in a second state allow fluid communication between the pharmaceutically acceptable solution and the ion exchange material, such as to allow contact therebetween.

5. The pre-filled syringe according to claim 4, wherein the separator is selected from the group consisting of a collapsible liquid impermeable membrane, a super-hydrophobic material, a valve, a damper and an air pocket.

6. The pre-filled syringe according to any one of the preceding claims, wherein the syringe comprises an injection needle mounted in fluid communication with said outlet.

7. The pre-filled syringe according to claim 6 wherein the ion exchange material is contained within said needle.

8. The pre-filled syringe according to any one of claims 1–7, wherein the porous solid material comprises a zeolite material, wherein the zeolite is an aluminosilicate zeolite material loaded with Na^+, H^+ and/or Ca^{2+} having

-a SiO_2/Al_2O_3 molar ratio above 1.5; and/or

-a Na_2O content below 10 wt-% of the total zeolite weight.

9. The pre-filled syringe according to claim 1, wherein said acidic buffer solution is a citrate buffer.

10. The pre-filled syringe according to any one of the preceding claims, wherein the pharmaceutically acceptable solution comprises a protein drug or peptide drug.

11. The pre-filled syringe according to claim 10, wherein the protein or peptide drug is an IL-1 receptor antagonist.

12. The pre-filled syringe according to claim 11, wherein the IL-1 receptor antagonist is anakinra.

13. A method for manufacturing a pre-filled syringe according to any one of the claims 1 to 12 comprising steps of:

a) providing a syringe having a plunger and a barrel, the barrel having an interior volume;

b) providing the syringe with an ion exchange material at a position that is not in fluid communication with the interior volume of the barrel;

c) placing a pharmaceutically acceptable solution within said barrel upstream of the ion exchange material.

14. The method according to claim 13, wherein the ion exchange material is provided within the barrel.

15. The method according to claim 13, wherein the ion exchange material is contained within a needle unit, and the step b) involves connecting said needle unit to the barrel.

16. The method according to claim 15, wherein the ion exchange material is a particulate zeolite material and wherein step b) comprises:

b-i) sintering the zeolite material to a shape such that it matches to the inner shape of a needle of the needle unit, and

b-ii) placing the sintered zeolite material within the needle.

17. The method according to claim 14, wherein the ion exchange material is a particulate zeolite material and wherein step b) comprises:

b-i) sintering a zeolite material to a shape such that it matches to the inner shape of the barrel, and

b-ii) placing the sintered zeolite material within the barrel.

18. The method according to any one of the claims 14 to 17, wherein the method further comprises a step of providing a separator in the barrel.

19. A syringe comprising a barrel and a plunger, the barrel having an interior volume adapted to contain a pharmaceutically acceptable solution having a non-physiological pH, wherein the syringe further comprises an ion exchange material provided within the syringe such that it is not in fluid communication with the interior volume of the barrel, and wherein the ion exchange material is provided along an ejection path from the syringe, allowing the pharmaceutically acceptable solution to contact the ion exchange material before being ejected from the syringe, wherein the ion exchange material is adapted to, upon contact with the pharmaceutically acceptable solution, adjust the pH of the solution from a first, non-physiological pH to a second pH, wherein the first, non-physiological pH is in the range of 3-6.6 and/or the second pH is in the range of 6.6-8.0, wherein the second pH is higher than the first non-physiological pH, wherein the ion-exchange material comprises a solid porous material, wherein the solid porous material comprises at least one material selected from the list consisting of a zeolite material, a polystyrene material or a mesoporous silica, and wherein the pharmaceutically acceptable solution comprises a drug and an acidic buffer solution, wherein the ion exchange material is loaded with positive ions selected from Na^+ and/or Ca^{2+}.

20. The syringe according to claim 19, wherein the second pH is in the range of 7.0-8.0.

21. The syringe according to claim 20, wherein the second pH is in the range of 7.1-8.0.

22. The syringe according to any one of claims 19-21, further comprising an injection needle mounted in fluid communication with an outlet of the barrel.

23. The syringe according to claim 22, wherein the ion exchange material is provided within the injection needle.

24. A kit comprising:

i) a pre-filled syringe according to any one of the claims 1 to 5; and

ii) a needle unit comprising the needle as defined in any one of claims 6 to 7.

25. The kit according to claim 24, wherein the pre-filled syringe comprises a separator as defined in claim 4.

26. The kit according to any one of claims 24-25, wherein the pharmaceutically acceptable solution is as defined in any one of claims 1 and 9-13.

27. A kit comprising:

i) a syringe according to any one of claim 19-23;

ii) a needle unit comprising the needle as defined in any one of claims 22-23.

28. The kit according to claim 27, wherein the syringe comprises a separator as defined in claim 4.