Claims

1. A method for monitoring deposit formation in a process comprising an aqueous flow, said method providing a feed flow of an aqueous liquid onto a receiving surface to be monitored, wherein the monitoring includes the steps of:

- illuminating at least part of said receiving surface with at least one light source;
- collecting visual data at a multitude of positions across said receiving surface;
- analyzing said visual data;
- classifying the quality and type of deposition attached to said receiving surface based on information obtained from said analyzed visual data; and
- computing a quantitative scaling and/or fouling indication of said receiving surface based on said classification,

wherein the classification of the quality and type of said depositions on said receiving surface is done in a computer by using one or more of the following: shape factors such as aspect ratio, size factors such as size distribution or mean size, color factors such as mean color, color distribution and brightness, of the depositions imaged.

2. A method according to claim 1, wherein the method includes the further steps of:

- adding to said feed flow of an aqueous liquid at least one fluorescent dye capable of staining at least one type of microbes;
- illuminating at least part of said receiving surface with at least two light sources, at least one of which uses light with a selected wavelength that excites a biofouling deposition stained by said at least one fluorescent dye;
- classifying the quality and type of biofouling deposition on said receiving surface based on fluorescence emission from said depositions in said analyzed visual data.

3. A method according to claims 1 or 2, wherein at least one of said light sources is emitting ultraviolet light.

4. A method according to any of claims 1 - 3, wherein the quantitative scaling and/or fouling indication of said receiving surface is based on one or more of the following: total fouling of said surface, fouling rate, color map of fouling, and/or share or ratio of each fouling type.

5. A method according to any of claims 1 - 4, wherein said receiving surface to be monitored is located in at least one monitoring cell having at least one inlet for said feed flow of an aqueous liquid and at least one outlet for a discharge flow from said monitoring cell.

6. A method according to claim 5, wherein said feed flow of aqueous liquid is introduced onto a receiving surface of said monitoring cell including at least one layer of a spacer applied on said surface, for distributing and moderating the liquid over said surface.

7. A method according to claim 6, wherein said visual data is collected from said spacer and said receiving surface.

8. A method according to any of claims 5 - 7, wherein the monitoring cell has a receiving surface that is impermeable.

9. A method according to any of claims 5 - 7, wherein the monitoring cell has a receiving surface that is a semipermeable membrane.

10. A method according to claim 9, wherein said semipermeable membrane produces from said feed flow a permeate part that is passing through said semipermeable membrane and a concentrate part that forms said discharge flow.

11. A method according to claim 9 or 10, wherein said semipermeable membrane includes a reverse osmosis, nanofiltration, ultrafiltration or a microfiltration semipermeable membrane.

12. A method according to any of claims 5 - 11, including the steps of:

- providing at least two monitoring cells to be monitored;
- connecting said monitoring cells in parallel with regard to the feed and discharge flows;
- collecting visual data of the surfaces of said at least two monitoring cells.

13. A method according to any of claims 1 - 12, wherein said process is a filtration process and is a reverse osmosis, nanofiltration, ultrafiltration or microfiltration process for treating at least one of the following: saline water, brackish water, circulated water, waste water, or industrial process water.

14. A method according to any of claims 1 - 13, wherein said quantitative indication of said deposition on said receiving surface, compared to a clean surface used as a reference, is used as an input parameter for automatic control of the addition of one or more chemicals to said feed flow.

15. A method according to claim 14, wherein said chemical is selected from the group of antiscalants, biocides, coagulant chemicals, oxidants, cleaning chemicals, polymers and/or any combination thereof.

16. An apparatus for monitoring deposit formation in a process comprising an aqueous flow, including:

– at least one feed inlet for said aqueous flow onto a receiving surface to be monitored;

- at least one light source adapted to illuminate at least part of said receiving surface;
- an imaging device arranged to be moved across said receiving surface to collect visual data at a multitude of positions across said surface;
- a data processing unit adapted to analyze said collected visual data;
- a classifying algorithm for classifying the quality and type of deposition attached to said receiving surface based on information obtained from said analyzed visual data; and
- a computer routine for computing a quantitative scaling and/or fouling indication of said receiving surface based on said classification,

wherein said data processing unit includes means for comparing the obtained visual data to stored reference data of shape factors such as aspect ratio, size factors such as size distribution or mean size, color factors such as mean color, color distribution and brightness, of the depositions imaged, in order to carry out classification of the quality and type of said depositions on said receiving surface.

17. An apparatus according to claim 16, comprising:

- means for adding at least one fluorescent dye to said feed flow of an aqueous liquid;
- at least two light sources, at least one of which uses light with a selected wavelength that excites a biofouling deposit stained by said at least one fluorescent dye;
- said classifying algorithm being configured to classify the quality and type of biofouling deposition on said receiving surface based on fluorescence emission from said depositions in said analyzed visual data.

18. An apparatus according to claims 16 or 17, wherein at least one of said light sources is an ultraviolet light source.

19. An apparatus according to any of claims 16 - 18, wherein said data processing unit includes means for computing a quantitative scaling and/or fouling indication of said receiving surface is based on one or more of the following: total fouling of said surface, fouling rate, color map of fouling, and/or share or ratio of each fouling type.

20. An apparatus according to any of claims 16 - 19, wherein said receiving surface to be monitored is located in at least one monitoring cell, said cell having at least one inlet for said feed flow of an aqueous liquid and at least one outlet for a discharge flow from said monitoring cell.

21. An apparatus according to claim 20, wherein said monitoring cell includes at least one spacer layer applied on said receiving surface, for distributing and moderating the liquid over said receiving surface.

22. An apparatus according to claim 21, wherein said imaging device is adapted to collect visual data both from said spacer and said receiving surface.

23. An apparatus according to any of claims 18 - 22, wherein the monitoring cell has a receiving surface that is impermeable.

24. An apparatus according to any of claims 18 - 23, wherein the monitoring cell has a receiving surface that is a semipermeable membrane.

25. An apparatus according to claim 24, wherein said monitoring cell has an outlet flow for a permeate part that is passing through said semipermeable membrane, and a discharge outlet for a concentrate part not passing through said semipermeable membrane.

26. An apparatus according to any of claims 18 - 25, comprising of at least two monitoring cells being connected in parallel with regard to their feed

and discharge flows, said imaging device being adapted to collect visual data of the receiving surfaces of said at least two monitoring cells.

27. An apparatus according to any of claims 16 – 26, wherein the computing of a quantitative indication of said depositions on said receiving surface is based on said classification as compared to a clean surface used as a reference, and is used as an input parameter for automatic control of dosing of one or more chemicals to said feed flow.

28. An apparatus according to claim 27, wherein said chemical dosing includes dosing of a chemical that is selected from the group of antiscalants, biocides, coagulant chemicals, cleaning chemicals polymers and/or any combination thereof.

29. The use of a monitoring apparatus according to any of the claims 16 – 19, 27 or 28 in a process plant to estimate agglomeration of impurities on a receiving surface of said plant with a method according to any of claims 1 – 4, 13 - 15.

30. The use of a monitoring apparatus according to any of the claims 19 - 28 in a filtration process plant, to estimate agglomeration of impurities in monitoring cells of said plant with a method according to any of claims 5 – 15.