

WE CLAIM:

1. A method for monitoring fouling of a two side membrane fouling process, wherein the said method comprising:
determining the process model for the said two side membrane fouling process;
grouping the parameters of the said process model based on the interactions thereof between the said parameters to form one or more groups of parameters;
estimating at least one key performance index in relation to the said one or more groups of parameters; and
monitoring the fouling of the said two side membrane fouling process correspondingly in relation to the said at least one key performance index.
2. A method for controlling fouling of a two side membrane fouling process, wherein the said method comprising:
determining the process model for the said two side membrane fouling process;
grouping the parameters of the said process model based on the interactions thereof between the said parameters to form one or more groups of parameters;
estimating at least one key performance index in relation to the said one or more groups of parameters; and
controlling the fouling of the said two side membrane fouling process correspondingly in relation to the said at least one key performance index by altering the flow of solution on either side or both sides of the said two side membrane.
3. The method as claimed in any one or both of claims 1 or 2, further comprising optimizing the two side membrane process by estimating optimal operating conditions for the said two side membrane process based on the objective function, and considering the fouling of the said two side membrane.
4. The method as claimed in claim 3, wherein the said objective function include one or more objectives such as increasing energy production, scheduling of membrane maintenance, distribution of load etc.

5. The method as claimed in any one of the preceding claims, wherein the said parameters include water permeability, solute permeability, reflection coefficient, mass transfer coefficient, Darcy's coefficient, flux, density, viscosity, diffusivity, velocity, flow rate, pressure, salt concentration, temperature etc.
6. The method as claimed in claim 5, wherein the said parameters is in corresponding relation to water and / or solute.
7. The method as claimed in claim 5 or 6, wherein the parameters is in corresponding relation to feed and / or draw solution.
8. The method as claimed in any one of the preceding claims, wherein the said key performance index include membrane fouling parameter of either side or both side of the said two side membrane in relation to feed and / or draw solution.
9. The method as claimed in any one of the claims 2 to 8, wherein altering the flow of solution is effected when the fractional change in the key performance index exceeds predetermined percentage of the threshold value.
10. The method as claimed in any one of the preceding claims, wherein the said method can be performed online or offline.
11. A system in a plant employing membrane separation process and / or power generation process, for one or more of monitoring, controlling and optimizing two side membrane process and of fouling thereof, in accordance with the method correspondingly claimed in any one of the preceding claims.

WE CLAIM:

1. A method for controlling fouling on a feed side and a draw side of a membrane wherein the feed side includes a feed solution and the draw side includes a draw solution, the method comprising:

providing a process model for operation of the feed side and draw side of the membrane, wherein the process model includes one or more parameters indicative of external concentration polarisation and internal concentration polarisation;

estimating a feed side key performance index and a draw side key performance index from the one or more parameters of the process model;

estimating fouling on the feed side and fouling on the draw side of the membrane based on the feed side key performance index and the draw side key performance index; and

altering flow of at least one of feed solution or draw solution based on the estimated fouling at the feed side and the estimated fouling at the draw side for controlling the fouling on the feed side and draw side of the membrane.

2. A method for controlling fouling of a two side membrane fouling process, wherein the said method comprising:

determining the process model for the said two side membrane fouling process;

grouping the parameters of the said process model based on the interactions thereof between the said parameters to form one or more groups of parameters;

estimating at least one key performance index in relation to the said one or more groups of parameters; and

controlling the fouling of the said two side membrane fouling process correspondingly in relation to the said at least one key performance index by altering the flow of solution on either side or both sides of the said two side membrane.

3. The method as claimed in any one or both of claims 1 or 2, further comprising optimizing the two side membrane process by estimating optimal operating conditions for the said two side membrane process based on the objective function, and considering the fouling of the said two side membrane.

4. The method as claimed in claim 3, wherein the said objective function include one or more objectives such as increasing energy production, scheduling of membrane maintenance, distribution of load etc.
5. The method as claimed in any one of the preceding claims, wherein the said parameters include water permeability, solute permeability, reflection coefficient, mass transfer coefficient, Darcy's coefficient, flux, density, viscosity, diffusivity, velocity, flow rate, pressure, salt concentration, temperature etc.
6. The method as claimed in claim 5, wherein the said parameters is in corresponding relation to water and / or solute.
7. The method as claimed in claim 5 or 6, wherein the parameters is in corresponding relation to feed and / or draw solution.
8. The method as claimed in any one of the preceding claims, wherein the said key performance index include membrane fouling parameter of either side or both side of the said two side membrane in relation to feed and / or draw solution.
9. The method as claimed in any one of the claims 2 to 8, wherein altering the flow of solution is effected when the fractional change in the key performance index exceeds predetermined percentage of the threshold value.
10. The method as claimed in any one of the preceding claims, wherein the said method can be performed online or offline.
11. A system in a plant employing membrane separation process and / or power generation process, for one or more of monitoring, controlling and optimizing two side membrane process and of fouling thereof, in accordance with the method correspondingly claimed in any one of the preceding claims.
12. The method as claimed in claim 1, further comprising scheduling cleaning of the feed side and the draw side of the membrane concurrently.