



JSC “RM Nanotech”

# Software User's Manual

**NanotechPRO v4**

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# 1 Functions of the Software

The software is designed to compute parameters of the reverse osmosis systems that use RM Nanotech's membrane elements and allows to predict performance of the elements in specific conditions.

The software employs the same 3 stage procedure as those used by other manufacturers:

1) Input of Feed Water Data

- balancing anions and cations with sodium or chlorides,
- use of several feed flows,
- use of water database,
- use of Na-softener or pH correction to prevent scaling.

2) System Configuration Selection

- use of multiphase and multistage configurations as well as recycles and admixtures,
- membrane element database with the possibility of using other manufacturers' membranes,
- database of frequently used industrial systems.

3) Estimation of Results

- report print-out or export to a PDF file,
- displaying warnings and recommendations.

As well:

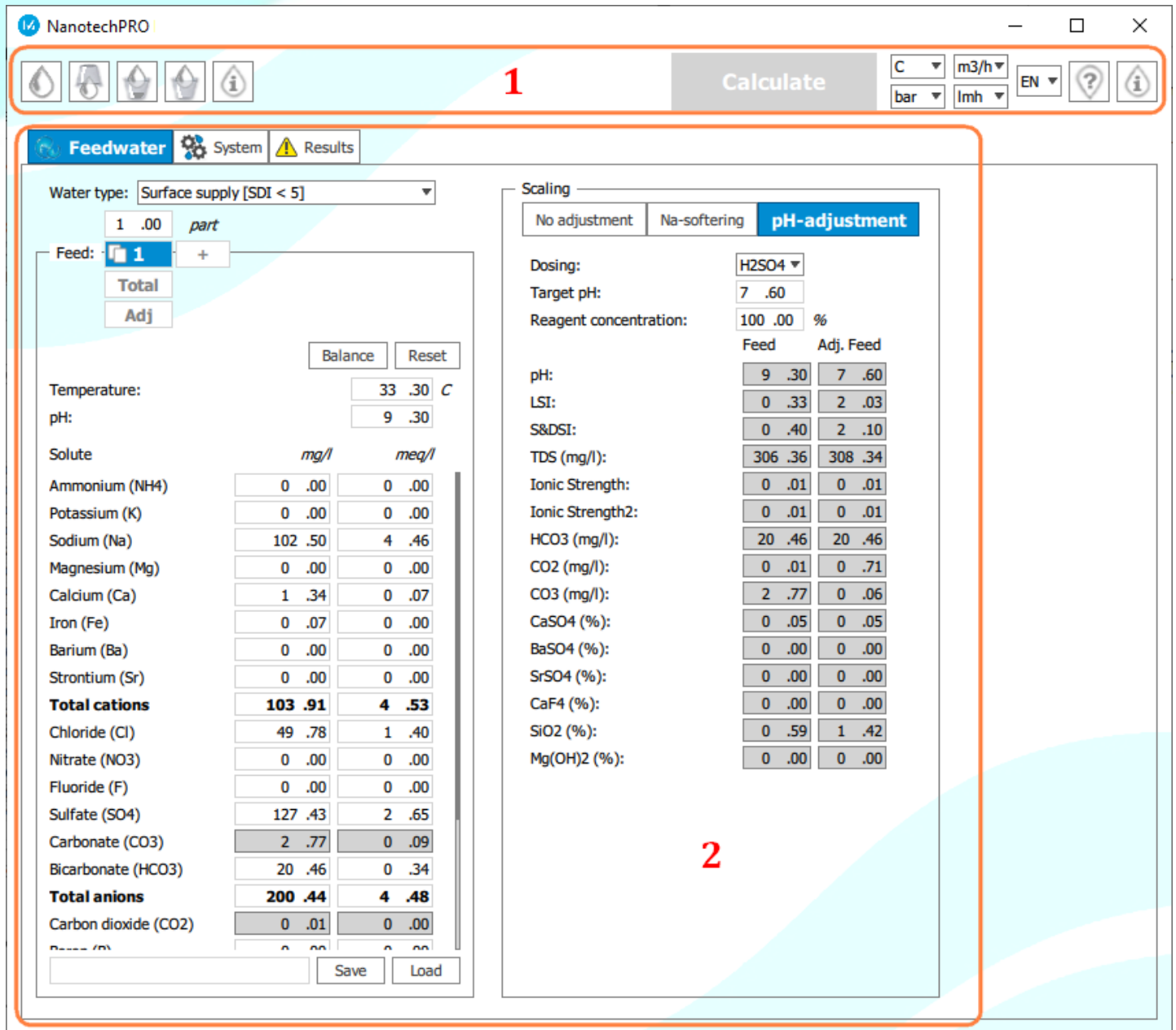
- user-friendly interface,
- save and upload for projects,
- use of various measurement units,
- warnings available at design phase.

## 2 Installation and Start-Up

The software installation is run with standard Windows Installer, to install the software it is required to show file directory. It requires a PC with Windows 7 64-bit or higher. The software is currently available in English and Russian.

### 3 Program's interface

The main window consists of two areas:



The upper area (1) contains settings and general tools:

- I. Tools to set measurement units for core system parameters (temperature, pressure, flow, specific permeate flux rate and also language of user interface):



Measurement units can be changed at any time with values being immediately recalculated.

II. Project-related buttons:



New Project



Open Project



Save the Opened Project



Save Project As New



About Project

III. Help button




IV. About button

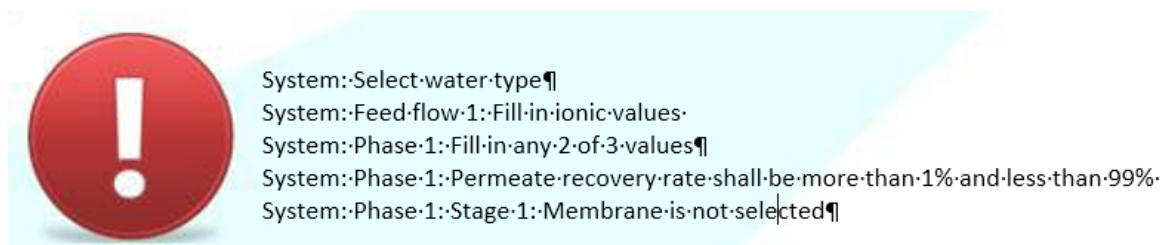


In the upper panel there is a button

**Calculate**

By pressing the button, the system will design the current reverse osmosis system. The button will only be active if there are no critical errors in the system.

*Critical error* is an error that precludes computation, e.g. field blank, incorrect details or parameters set incorrectly. Such fields will be accordingly marked with a symbol.  A full list of errors in the system is on the "Results" tab. Here is an example of an error window:



Each listed message indicates error source and error correction method..

*Non-critical errors or warnings* represent the second type of errors displayed in the system. For example, a warning occurs when feed water is not anion and cation-balanced or if the maximum permeate recovery rate is exceeded for a membrane element. Warnings are marked with the symbol.

The contents of the rest of the area (2) depend on a tab selected. Each tab helps setting certain parameters of the system.

Tabs are depicted in the figure below:



### 3.1 "Feed Water" Tab

The tab has the following contents:

Feed-flow control tool

Raw water's analysis data

Raw water's adjustment data

Water database controls

Feed-flow control tool:

It's the rate ratio of selected feed flow as a part of system raw flow

use to add new feed

use to delete feed

use to display system raw water's analysis data (system raw water is a result of mixing of feed flows)

If the system uses various feed-flow modifiers from a "Sedimentation" block, a corrected-flow button ("Corr.") will appear under the total-flow button.

The following data can be changed for every flow:

- Temperature
- pH
- Concentration of ions

Data on ions can be set in mg/l or meq/l.

The «Reset» button set all concentrations equals zero.

When the value is specified in the field "Total cations" or "Total anions" the values of individual ions are changed proportionally of their current values so that the total value is fit the specified value.

Use «Balance» button to adjust electroneutrality of solution by addition of a required amount of sodium or chlorine ions.

When a value is entered in the "TDS" field, the automatically calculated amount of sodium and chlorine ions is added to the solution, ensuring electroneutrality and bringing the total dissolved salts to the specified value. The concentrations of all other ions is not changed. If it is impossible to achieve the entered TDS value (for example, the entered value is less than the sum of the ions specified) it is recalculated in accordance with the described principle.

"Save" and "Download" buttons allow saving and downloading water parameters from water database.

By pressing the "Download" button, the following window will appear:

User	Seawater	Well Water	Surface Supply	Test
Исаковское водохранилище (г. Коммунарск)				
Луганское водохранилище (п. Мироновский)				
Терновское водохранилище (г. Курахово)				
пруд Несветай				
Черенетская ГРЭС (г. Красный Сулин)				
озеро Байкал				
озеро Балхаш (г. Суворов)				
река Амударья (г. Керки)				
река Амур (г. Хабаровск)				
река Ангара (г. Ангарск)				
река Волга (г. Ярославль)				

Buttons on the top of the window are used to select the type of water source.

In this window, the user will select water type (user; Seawater; Surface supply) by switching between the above buttons.

To save the selected water type, the user have to enter it in a field near the "Save" button and press the "Save" button. The selected water type will be added to user water group.

In the "Scaling" block the user may either use the softener or adjust pH:

Scaling

**No adjustment** Na-softening pH-adjustment

In the "Na-softener" tab, the user can set Ca and Mg target values for feed water with the difference between the source and target values being converted to Na:

No adjustment **Na-softening** pH-adjustment

Ca Leakage:   mg/l  
 Mg Leakage:   mg/l

The "pH-adjustment" tab allows setting acid and alkali for dosing, target pH, and solution concentration:

No adjustment Na-softening **pH-adjustment**

Dosing:  ▾  
 Target pH:    
 Reagent concentration:   %

The display data of the "Scaling" block reflect the system's raw flow properties as they are before and after of chemical correction:

	Feed	Adj. Feed
pH:	<input type="text" value="9"/> <input type="text" value=".30"/>	<input type="text" value="7"/> <input type="text" value=".60"/>
LSI:	<input type="text" value="0"/> <input type="text" value=".33"/>	<input type="text" value="2"/> <input type="text" value=".03"/>
S&DSI:	<input type="text" value="0"/> <input type="text" value=".40"/>	<input type="text" value="2"/> <input type="text" value=".10"/>
TDS (mg/l):	<input type="text" value="306"/> <input type="text" value=".00"/>	<input type="text" value="307"/> <input type="text" value=".99"/>
Ionic Strength:	<input type="text" value="0"/> <input type="text" value=".01"/>	<input type="text" value="0"/> <input type="text" value=".01"/>
Ionic Strength2:	<input type="text" value="0"/> <input type="text" value=".01"/>	<input type="text" value="0"/> <input type="text" value=".01"/>
HCO3 (mg/l):	<input type="text" value="20"/> <input type="text" value=".46"/>	<input type="text" value="20"/> <input type="text" value=".46"/>
CO2 (mg/l):	<input type="text" value="0"/> <input type="text" value=".01"/>	<input type="text" value="0"/> <input type="text" value=".71"/>
CO3 (mg/l):	<input type="text" value="2"/> <input type="text" value=".77"/>	<input type="text" value="0"/> <input type="text" value=".06"/>
CaSO4 (%):	<input type="text" value="0"/> <input type="text" value=".05"/>	<input type="text" value="0"/> <input type="text" value=".05"/>
BaSO4 (%):	<input type="text" value="0"/> <input type="text" value=".00"/>	<input type="text" value="0"/> <input type="text" value=".00"/>
SrSO4 (%):	<input type="text" value="0"/> <input type="text" value=".00"/>	<input type="text" value="0"/> <input type="text" value=".00"/>
CaF4 (%):	<input type="text" value="0"/> <input type="text" value=".00"/>	<input type="text" value="0"/> <input type="text" value=".00"/>
SiO2 (%):	<input type="text" value="0"/> <input type="text" value=".59"/>	<input type="text" value="1"/> <input type="text" value=".42"/>
Mg(OH)2 (%):	<input type="text" value="0"/> <input type="text" value=".00"/>	<input type="text" value="0"/> <input type="text" value=".00"/>



### 3.2 "System" Tab

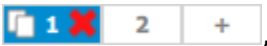
The tab has the following contents:

The screenshot shows the 'System' tab interface with the following components:

- System Parameters:**
  - Element lifetime: 0 year(s)
  - Flow factor: 1.00
  - System raw water: 74.50 m3/h
  - Total elements in system: 48
  - System recovery: 66.31 %
- Buttons:** 'Generic schemes' and 'Reset scheme'
- Pass 1 Data:**
  - Permeate flow (P1): 49.40 m3/h
  - Recovery: 66.31 %
  - Feed flow (F1): 74.50 m3/h
  - Average flux: 26.38
  - Blend permeate (B1): 0.00 m3/h
  - Self Recycle (SR1): 0.00 m3/h
  - Back pressure: 0.00 bar
- Stage 1 Data:**
  - Vessels count: 8
  - Elements per vessel: 4
  - Total elements count: 32
  - Pre stage pressure: 0.00 bar
  - Membrane element: KC 8040-C
- Interactive flow diagram:** Shows a process flow starting with a green lightbulb icon, passing through a stage labeled '8#4' (with a red 'X' icon), then through a stage labeled '4#4', and finally exiting through a '+' icon. A blue line labeled 'P1' indicates a permeate stream.

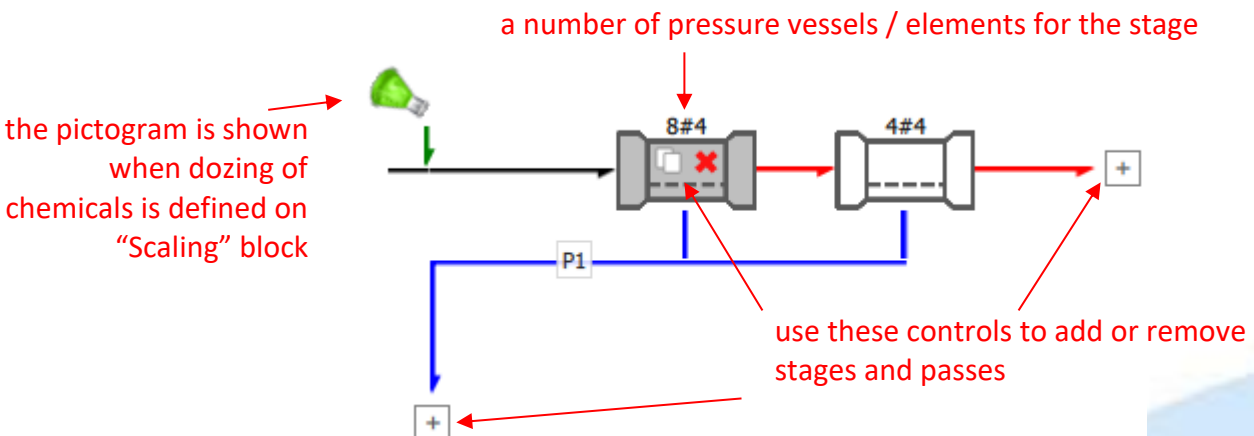
The stage data (on the pass selected)

To add or delete stages and passes in the system use controls in the appropriate group boxes:



or use an interactive flow diagram.

System data are depicted in the flow diagram on the right:



The software provides the possibility of choosing from frequently encountered flow diagrams and booting them by pressing the "Flow Diagram Variants" button.

Feed flow volume, permeate recovery rate and permeate flow volume are interrelated quantities, that is why only two of them can be changed at a time. The third quantity is calculated automatically.

Mixing is possible only in the last pass. If the system has a single pass the admixture is added to the input stream to the system (System raw water). If the system has two passes, the admixture is deducted from the filtrate of the previous stage.

Membrane element's type can be selected either in a drop-down list

Membrane element:

either in the dialog box that opens when you click on the button to the right of the list:

Choose membrane element ✕

Elements alternatives

Model	Area (m <sup>2</sup> )	Productivity (m <sup>3</sup> /h)	Rejection (%)	Test conditions		
				Soln. (%)	Pres. (bar)	Recov. (%)
KC 4040-C	7.99	0.39	99.7	NaCl 0.15%	15.00	15
KC 4040-C2	7.53	0.36	99.7	NaCl 0.15%	15.00	15
KC 4040-C3	7.15	0.35	99.7	NaCl 0.15%	15.00	15
KC 8040-C	39.02	1.81	99.7	NaCl 0.15%	15.00	15
KC 8040-C2	37.16	1.73	99.7	NaCl 0.15%	15.00	15
KC 8040-C3	34.84	1.62	99.7	NaCl 0.15%	15.00	15
KCH 4040-C	8.64	0.41	99.1	NaCl 0.05%	6.90	15

The “Elements alternatives” button shows the conformance table of RM Nanotech's membrane elements and membrane elements of other manufacturers:


Choose membrane element ✕

Elements parameters



Nanotech	Dow	CSM	Hydranautics	TORAY	KOCH	DESAL/GE
KC 4040-C	LC HR-4040	RE4040-BE	CPA5-LD-4040	TM710D	4040-XR	AG-90
KC 8040-C	BW30HR-440I	RE8040-UL440	CPA5 MAX	TM720-440	8040-XR-400	AG-440
KC 8040-C2			CPA3		8040-XR-375	
KC 8040-C3	BW30FR-365		CPA2	TM720D-400		AG-400, 34
KCH 4040-C	XLE-4040	RE4040-BLF	ESPA4-4040	TMH10A	4040-ULP	AK4040FM
KCH 4040-F	XLE-4040					
KCH 8040-C	XLE-440	RE8040-BLF	ESPA4	TMH20A-440	8040-ULP-400	AK8040F400
KCH 8040-C3			ESPA4-LD	TMH20A-370		
KH 4040-C	LE-4040	RE4040-BLN	ESPA2-4040	TMG10		
KH 8040-C	LE-400	RE8040-BLN	ESPA1	TM720L-400		
KM 4040-C	SW30-4040	RE4040-SHF	SWC6-4040	TM810V	4040-HF	AD4040FF
KM 8040-C	SW30XLE-440I		SWC5-MAX	TM820V-440		AE-440
KM 8040-C2	SW30XLE-400I	RE8040-SHF400			8040-HF-400	
KM 8040-C3			SWC5-LD	TM820V-400		AE-400, 34


### 3.3 "Results" Tab

This tab contains a table of calculated system parameters, including list of errors and warnings. If the calculation is successful the consolidated report is shown on this tab:

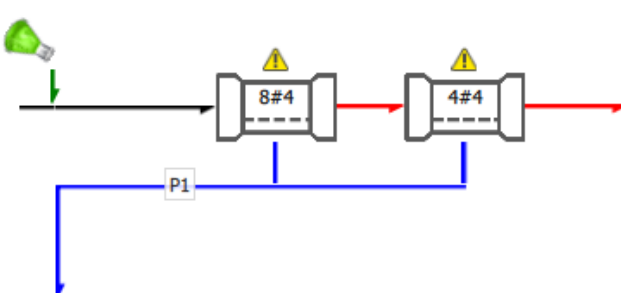


System has been calculated



System: Pass 1: Stage 1: Element 3: Recovery should be less than 15%  
System: Pass 1: Stage 1: Element 4: Recovery should be less than 15%



#### System details

**Common**

		Surface supply [SDI < 5]	
Water type			
Temperature	<i>C</i>	33.30	Raw water flow
Flow Factor		1	<i>m3/h</i> 74.50
Power	<i>kW</i>	19.66	Stage 1 feed flow
Specific energy	<i>kWh/m3</i>	0.40	<i>m3/h</i> 74.50
Active Area	<i>m2</i>	1872.96	Feed TDS
Total elements count		48	<i>mg/l</i> 306.36
Element lifetime	<i>year(s)</i>	0	Feed pressure
Avg. Flux	<i>lmh</i>	26.38	<i>bar</i> 7.60
Recovery	<i>%</i>	66.31	Feed osmotic pressure
Rejection	<i>%</i>	98.64	<i>bar</i> 0.19
			Feed pH
			Permeate flow
			<i>m3/h</i> 49.40
			Permeate TDS
			<i>mg/l</i> 4.15
			Permeate pressure
			<i>bar</i> 0
			Permeate pH
			6.26

**Streams**

		Feed	Adj. feed	Stage 1 feed	Concentrate	Permeate
Na	<i>mg/l</i>	102.50	102.50	102.50	301.55	1.37

In the upper right corner of the tab the buttons are placed for exporting of the report:



to printer



into file in PDF format

## 4 Contacts

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