AquaPro Design Software User Manual

Leadership in Filtration

MANN+HUMMEL

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Note

Any user of MANN+HUMMEL AquaPro Design Software (the “Software”) acknowledges and agrees that the Software is considered proprietary, and that MANN+HUMMEL is the sole owner of the Software pursuant to the intellectual property laws of the United States, Europe, and all other applicable jurisdictions, including at least patent, copyright, and trade secret law.

The Software is provided only for and expressly to customers interested in this MANN+HUMMEL product. Any use beyond such limited license is expressly forbidden and may result in legal action where appropriate. The Software is provided only to those with a need to use it for this express product, and acceptance or use of the Software constitutes an acceptance of a non-disclosure agreement with respect to the existence and functionality of the Software. Any and all attempts to reverse engineer the product or software are expressly forbidden

Warranties, contractual obligations, or disclaimers associated with the Software

The information provided in the AquaPro Design Software User Manual and in the Projection Reports generated by the Software is for informational purposes only and does not constitute a guarantee, promise, or representation of future performance.

The use of the Software, its Manual, and the Projection Reports is at the user’s own risk. The projections are based on current assumptions and estimates, which are subject to change. Actual results may vary materially. The user should not rely upon this report and is encouraged to perform their own due diligence or consult with a qualified advisor.

MANN+HUMMEL is not liable for any consequences resulting from use, except in cases of intent and gross negligence.

Exception for EU: The same applies to injury to life, limb, or health; to the breach of essential contractual obligations; and under the German Product Liability Act.

List of illustrations

Introduction

Audience description

The Software is intended to be used by persons having the requisite technical skill at their own discretion and risk.

Applicability statement

In water purification applications with a well-pretreated feed, the expected performance of MANN+HUMMEL UF, RO, and NF membranes can be reasonably projected using MANN+HUMMEL's AquaPro projection software. However, many situations require various qualification and testing steps prior to the start-up of a full-scale system. Some such situations include variable or difficult feed quality, process applications, large plant sizes, the presence of organics or silica, and unique or novel applications. Small-scale testing to ensure that the desired separation is achievable at appropriate pressures, membrane flux, and recovery rates is critical to verify the sustainability of full-scale operation, minimize risk, and fine-tune appropriate operating conditions.

Pilot testing is the most effective testing method used to assess a membrane's feasibility for a specific feed supply. The goals of piloting can include gathering pretreatment data, determining scaled-up operational characteristics and costs, testing cleaning regimens, ensuring stable operation over time with adequate permeate quality, familiarizing operators with the membrane technology, and demonstrating regulatory compliance. RO or NF pilot plants should use at least one 40-inch-long element, and the system configuration should mimic that of the scaled system. Pilot systems should run for a minimum of one month, although longer durations allow for a more accurate study of membrane fouling effects. The permeate flow rate of the pilot should be no less than 1% of the scaled system permeate flow rate.

One of the most important goals of a pilot plant is studying the fouling effects over time and ensuring that an effective and economic cleaning regimen can be implemented to maintain membrane performance. Cleaning cycles, controls, chemical feed equipment, and post treatment should all be considered. A site-specific understanding of fouling tendencies is especially necessary for complex feed qualities.

Problem reporting instructions

MANN+HUMMEL appreciates feedback. For suggestions to improve or to report problems, please email us at software.wms@mann-hummel.com.

Installation

Requirements: PC with Windows 10 or 11

Note: This revision of the application will not operate on Mac operating systems, nor will it operate on mobile phones or tablets.

Saving files

Projects are saved as .json files in the local computer. JSON (JavaScript Object Notation) is a file format for data storage and transmission.

How to use AquaPro Design Software for RO and NF projections

HOME

- Define the treatment goal and pick a membrane element.
- Determine the appropriate flux rates from the feed water quality.
- Use the average flux rate to size the system.
- Develop a sensible system design.
- Project the system design to verify that the treatment goal is accomplished.

Figure 1: Start with RO & NF

GETTING STARTED

1. Navigate to **Start**, then select **Start with RO & NF**.
2. Select **Units** to choose units of flow, temperature, pressure, and flux.
3. Select the relevant water type and profile from the drop-down lists.
4. Specify the feed water analysis.
5. Specify pass properties such as membrane age and flux decline.
6. Specify the required flow rates and recoveries.
7. Specify the number of stages, passes, vessels, and elements.
8. Select the element model from drop-down lists.
9. Save the project, calculate the results, and save the report.

PROJECT INFORMATION

Click  to enter the project information.

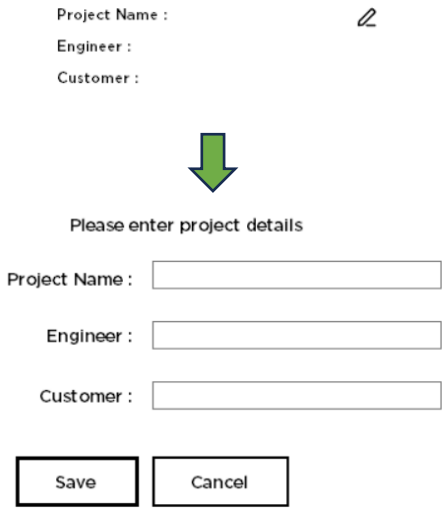


Figure 2: Project information selection

UNITS

Click  to open the **Units** page, where the preferred units of measurement can be set as default.

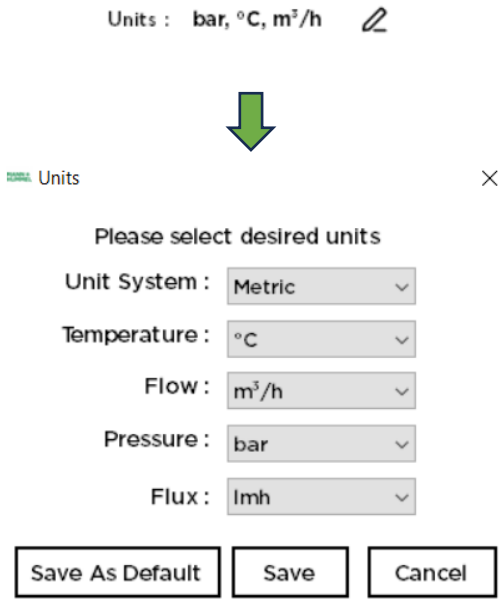


Figure 3: Units of measurement selection

FLOW DIAGRAM PAGE

This is the main page where the RO or NF systems can be configured by choosing the element type, the number of elements, and the number of stages and passes.

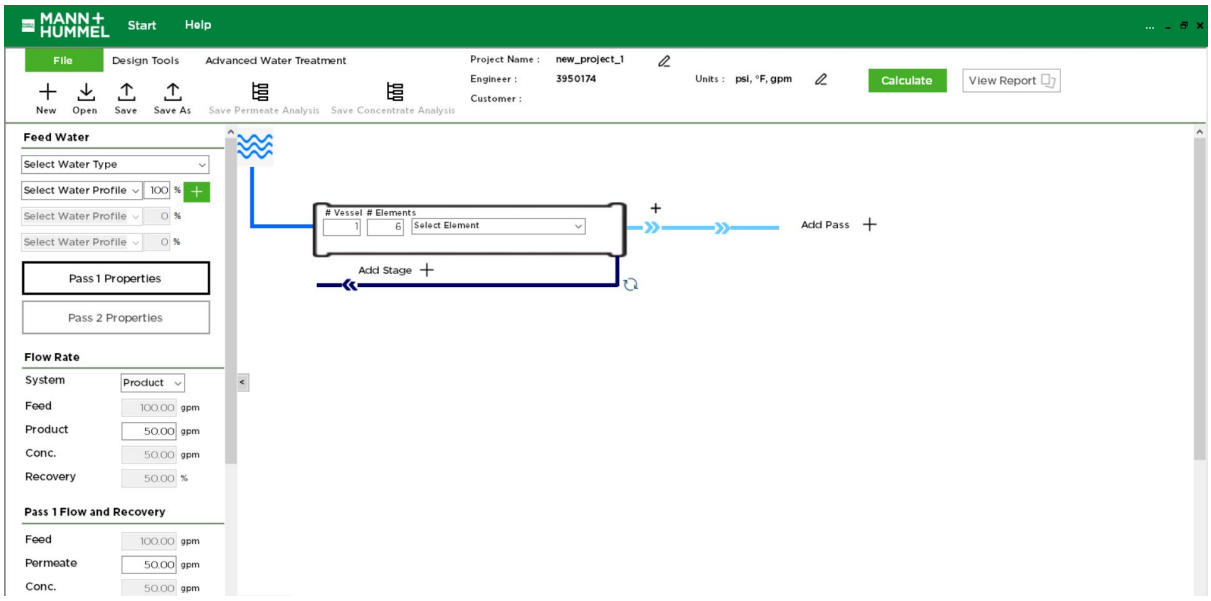


Figure 4: Flow diagram selection

WATER TYPE

Click **Select Water Type** to select the feed water type.

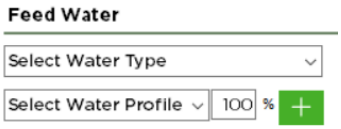


Figure 5: Water type selection

WATER PROFILE ANALYSIS

Click **Select Water Profile** to select an existing water analysis. Click + to create a new water profile or modify an existing one.

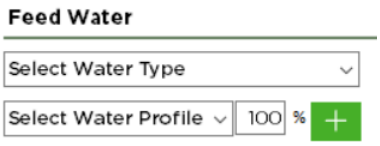


Figure 6: Water profile selection

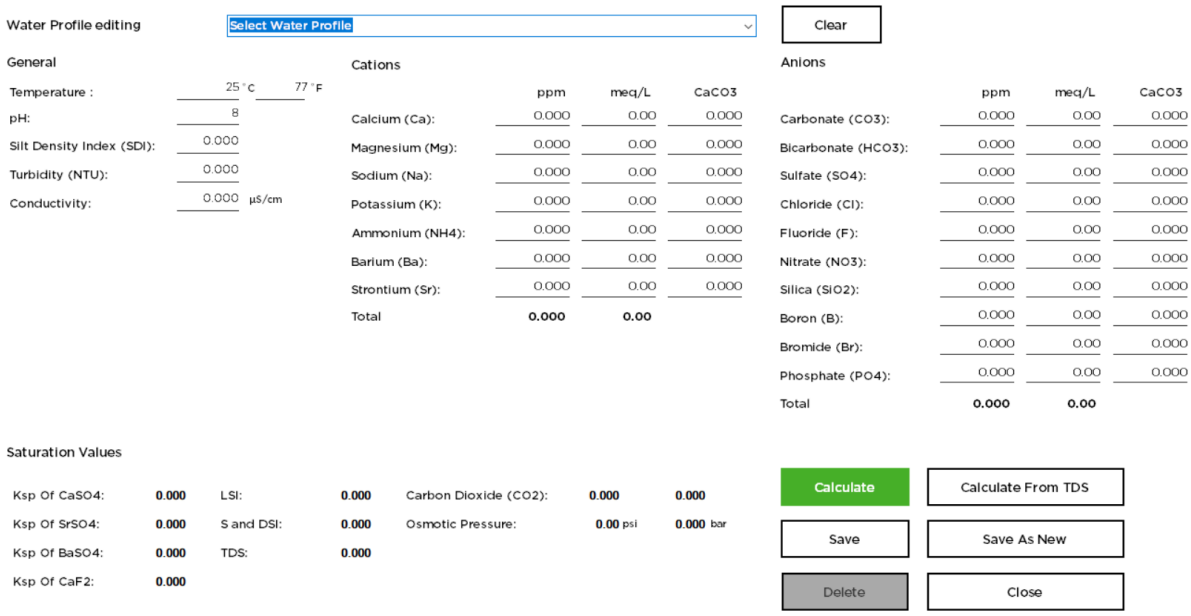


Figure 7: Water profile analysis selection

Click **Calculate From TDS** to create a NaCl or $MgSO_4$ water analysis based on the selected TDS.

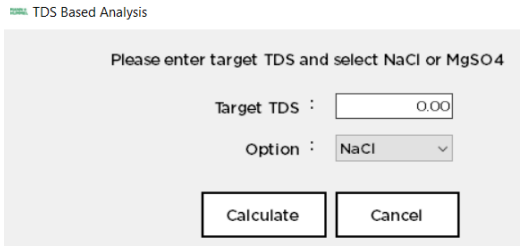


Figure 8: Water profile analysis – Calculate from TDS

PASS PROPERTIES

Click 

to select the water temperature and membrane age.

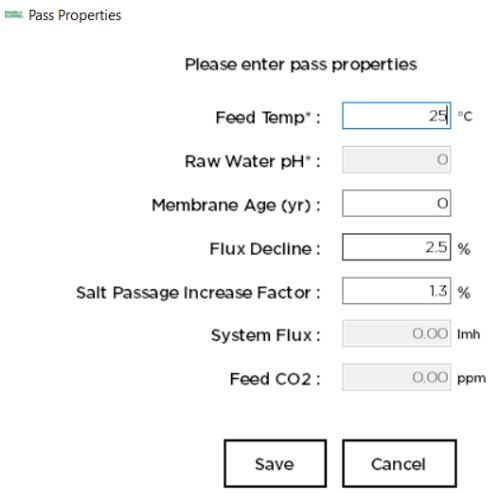


Figure 9: Pass properties selection

DESIGN TOOLS

Figure 10: Available design tools in flow diagram

The following are available from the **Design Tools** selection in the Flow Diagram:

- Interstage pump
- Energy recovery device (ERD)
- Permeate takeoff
- Feed bypass

INTERSTAGE BOOSTER PUMP

Click **Pump** to select the position of the booster pump. Click **+** to add the permeate back pressure.

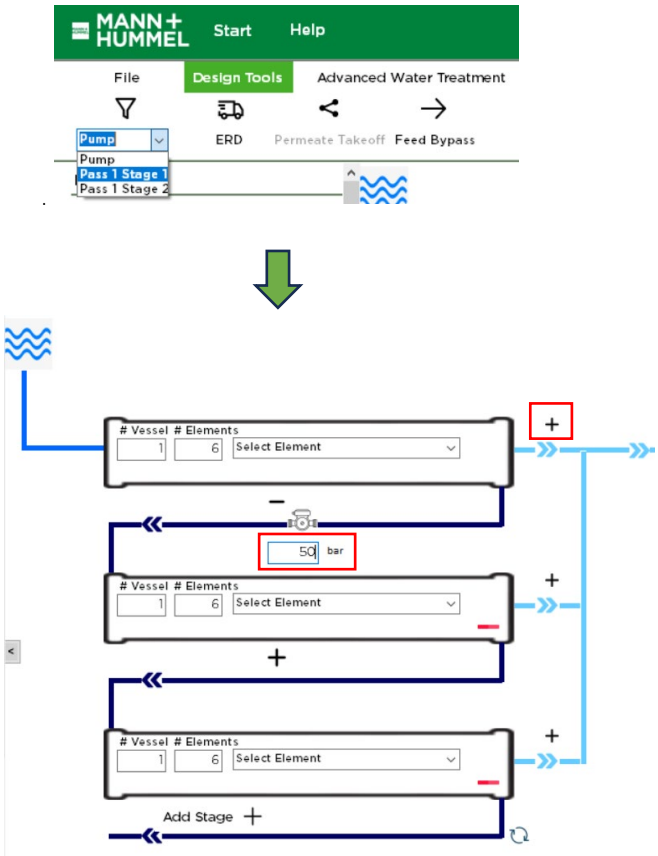


Figure 11: Interstage booster pump and permeate back pressure selection

ENERGY RECOVERY DESIGN

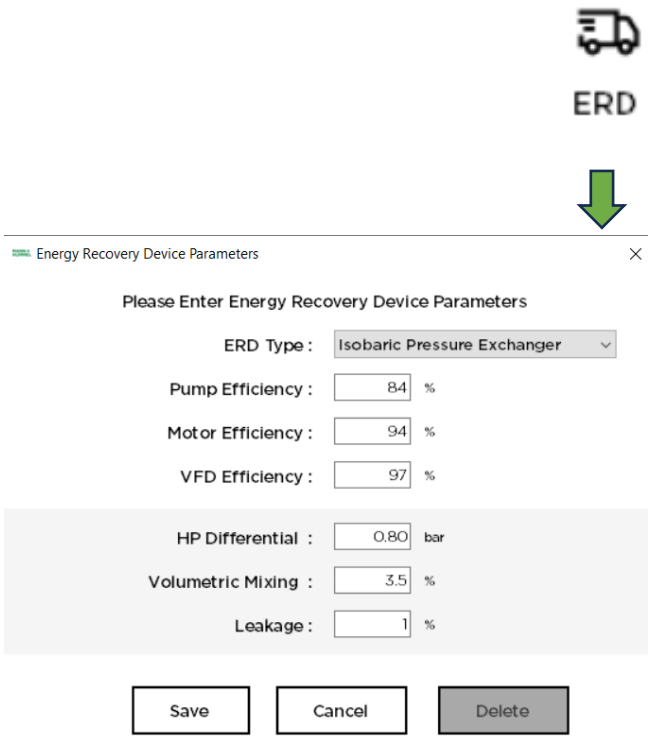


Figure 12: Standard energy recovery device parameters

PERMEATE TAKEOFF

Permeate takeoff is available with 2-pass designs, as shown below:

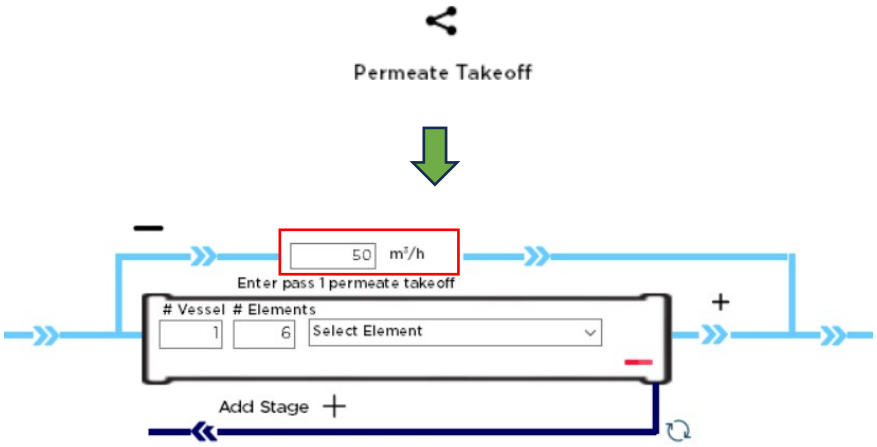


Figure 13: Example of permeate takeoff

FEED BYPASS

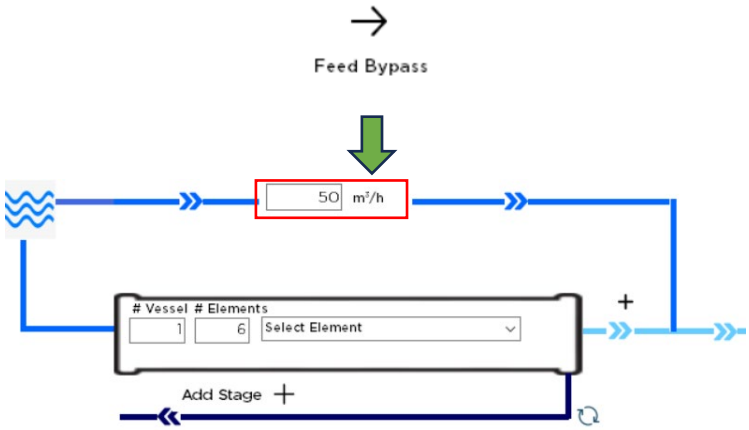


Figure 14: Example of feed bypass

ADVANCED WATER TREATMENT

Available advanced water treatments are as follows:

- Chemical dosing
- CO_2 stripping

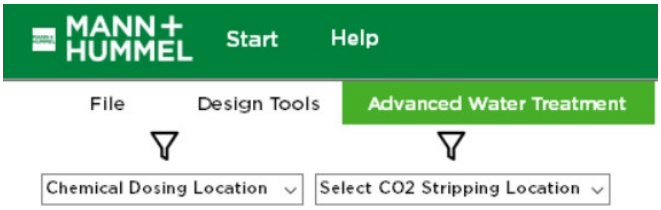
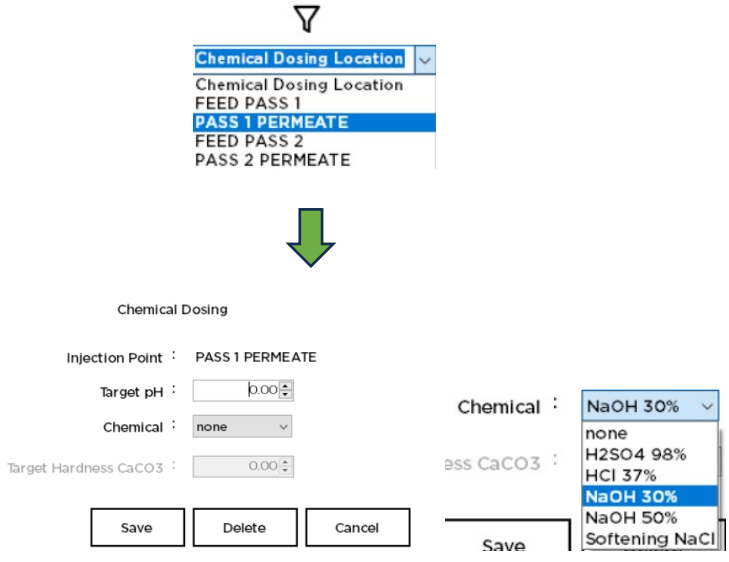


Figure 15: Advanced water treatment

CHEMICAL DOSING



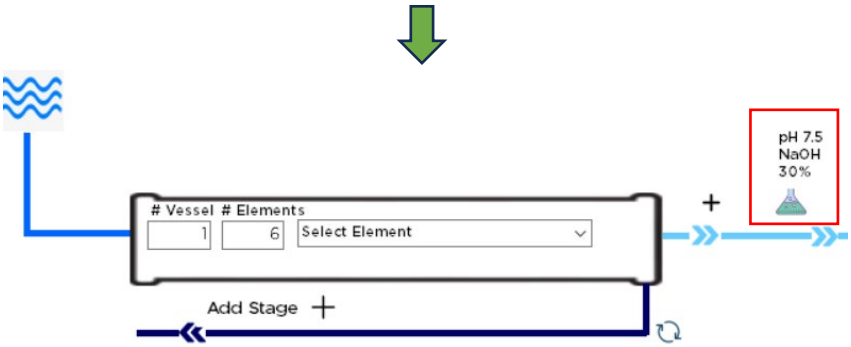


Figure 16: Example of chemical dosing

CO_2 STRIPPING

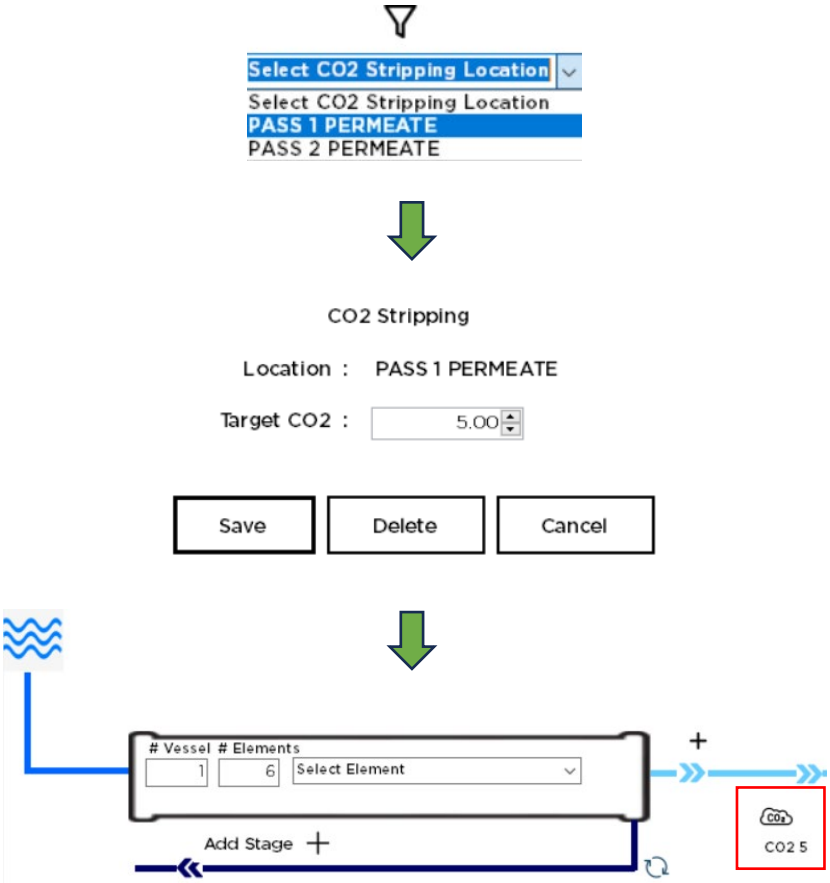


Figure 17: Example of CO_2 stripping

CALCULATE

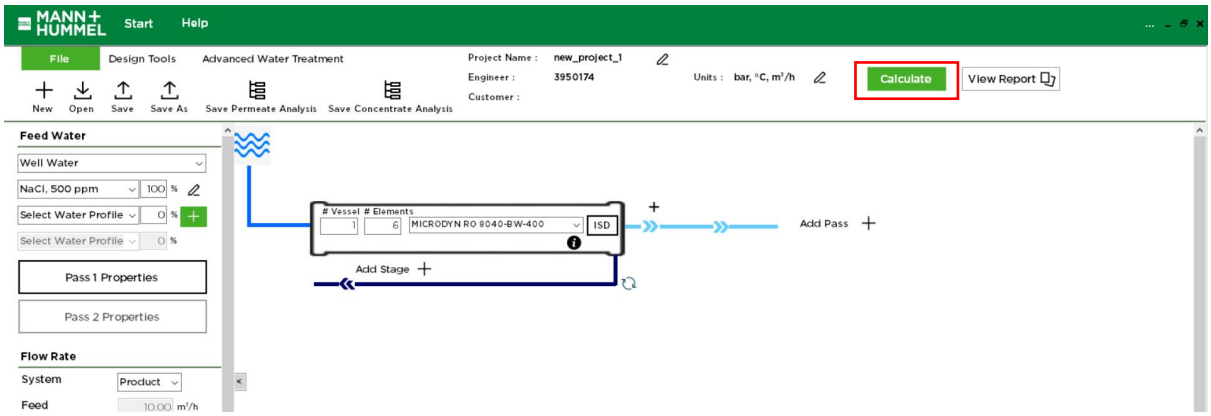


Figure 18: Example of calculation selection for the flow diagram

Warnings will be highlighted in red in the Summary Table displayed at the bottom of the Flow Diagram and in the warning summary (available by clicking ⚠).

Click ℹ to open the selected **Element Datasheet**.

Click ISD to make an **Internally Staged Design (ISD)**.

Click Save Permeate Analysis or Save Concentrate Analysis to save the permeate or the concentrate analysis.

VIEW REPORT

Once ready to generate the projection report, please click **View Report**.

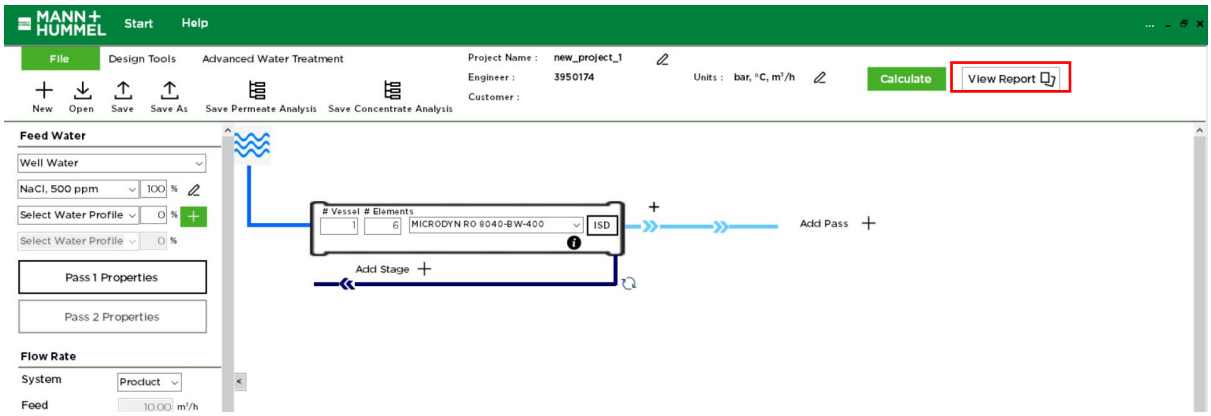


Figure 19: Example of view report selection from the flow diagram

A PDF file will be generated, and the user can save and/or print the report. An example is shown below:

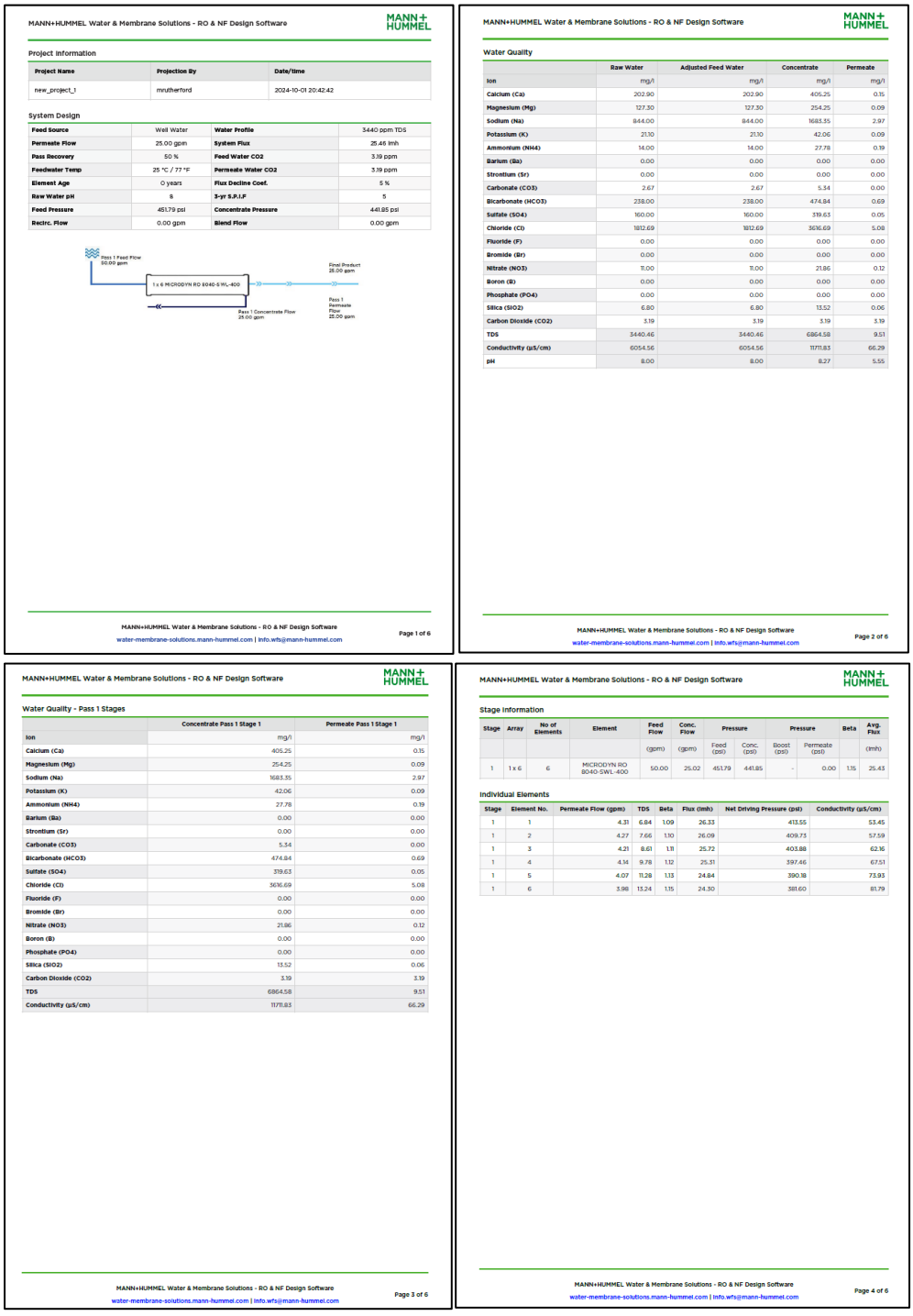


Figure 20: Example of design projection PDF report

An Excel report may be generated after the **View Report** button is selected.

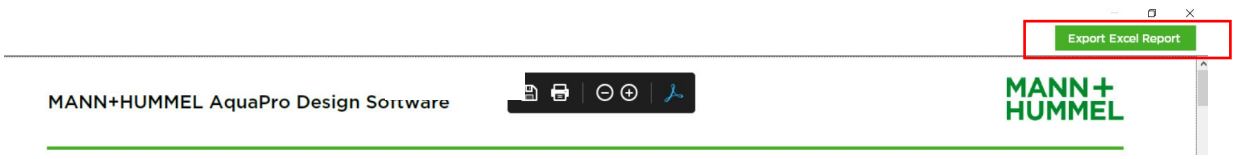


Figure 21: Example of exporting Excel report selection

How to use AquaPro Design Software for UF projections

HOME

- Define the treatment goal and pick a membrane element.
- Determine the appropriate flux rates from the feed water quality.
- Use the flux rate to size the system.
- Develop a sensible system design.
- Project the system design to verify that the treatment goal is accomplished.

Figure 22: Start with UF

GETTING STARTED

1. Navigate to **Start**, then select **Start with UF**.
2. Select **Units** to choose units of flow, temperature, pressure, and flux.
3. Select the relevant water type.
4. Specify the feed water analysis.
5. Specify the required flow rates.
6. Specify the gross flux, filtration cycle, and other design parameters.
7. Select the element model from drop-down lists.
8. Save the project, calculate the results, and save the report.

UNITS

Click to open the **Units** page, where the preferred units of measurement can be set as default.

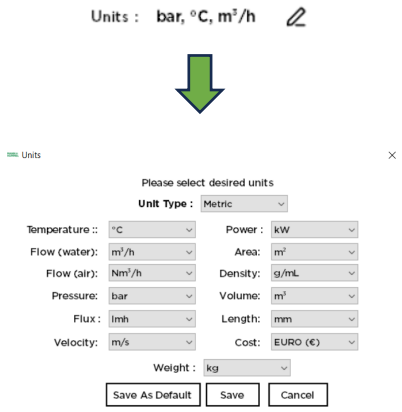


Figure 23: Units of measurement selection

PROJECT INFORMATION

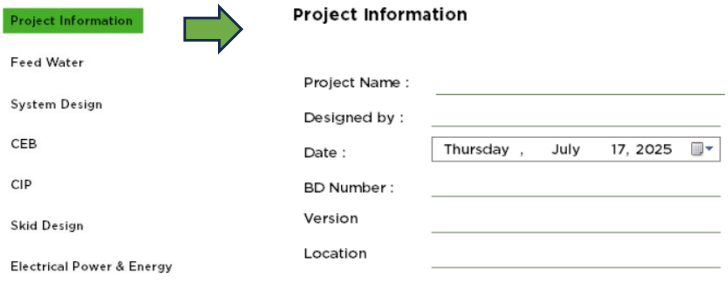


Figure 24: Project information selection

WATER PROFILE ANALYSIS

Click **Water Source** to select the feed water type and input water details. If information is not available, use the value "0." The resulting design may vary with different input value.

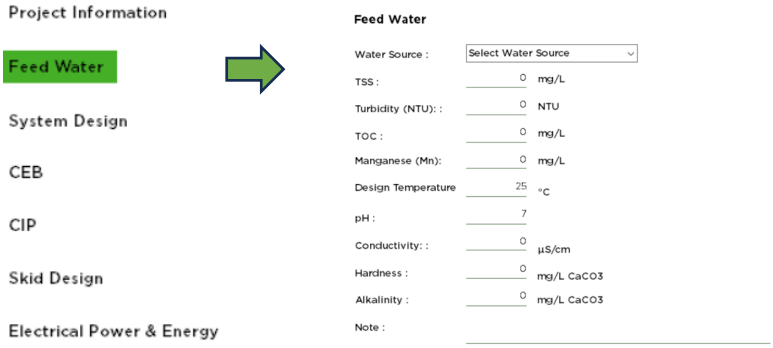


Figure 25: Water profile analysis selection

SYSTEM DESIGN

Click **Calculation At**, select **Permeate Flow Rate** or **Feed Flow Rate**, and input the required water flow rate. Then click **Select Module** and select the UF module. Other system design inputs are default values and can be adjusted as needed.

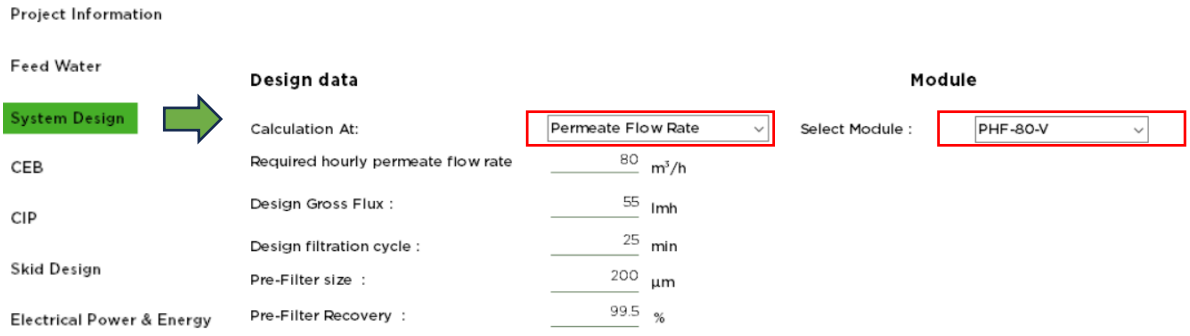


Figure 26: System design selection

CHEMICALLY ENHANCED BACKWASH (CEB)

Current inputs are default values and can be adjusted as needed. **Dosing at Feed** can be selected based on system requirement.

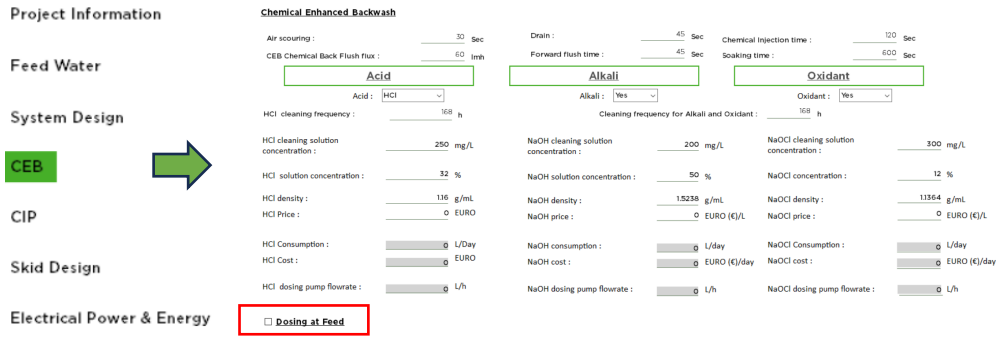


Figure 27: CEB selection

CLEAN-IN-PLACE (CIP)

Current inputs are default values and can be adjusted as needed.

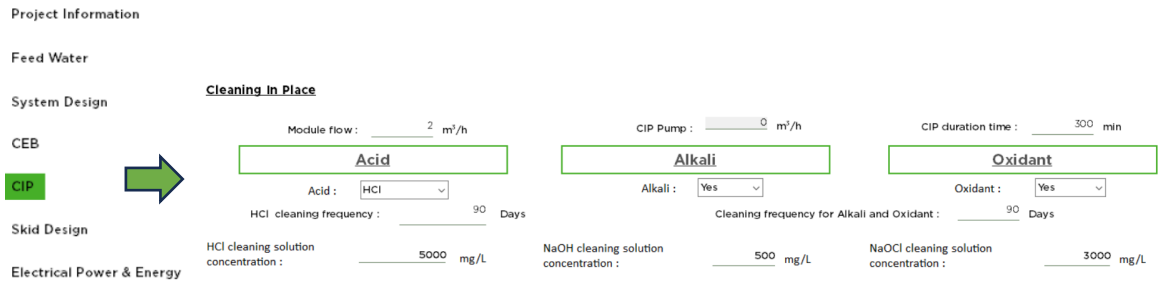


Figure 28: CIP selection

SKID DESIGN

Enter **Number of Racks**. (This can also be adjusted after the calculation is done.) Other skid design inputs are default values and can be adjusted as needed.

Figure 29: Skid design selection

ELECTRICAL POWER & ENERGY

Pump pressure and efficiency can be adjusted based on customer site information.

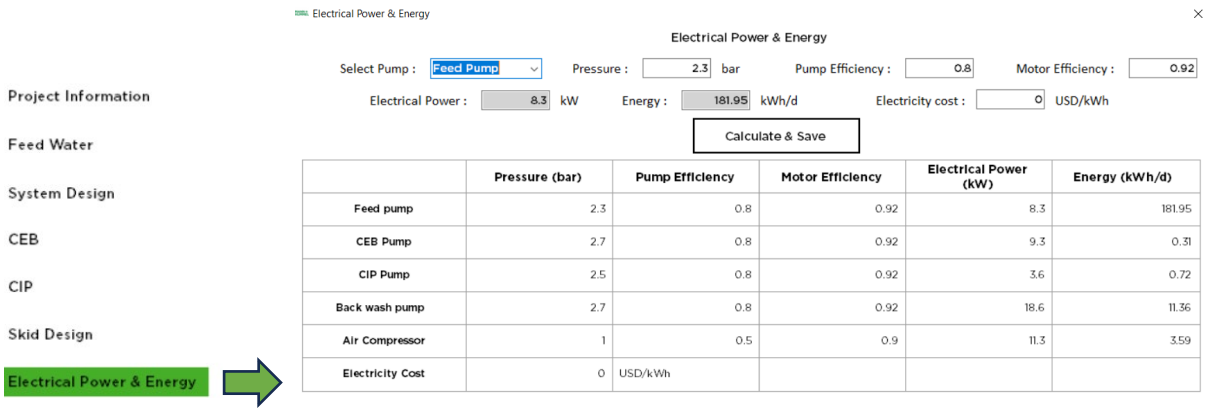


Figure 30: Electrical power & energy selection

CALCULATE

Once all inputs are finished, click **Calculate**. If any adjustments are made after calculation, click **Calculate** again to update.

Figure 31: Calculate

REPORT

Figure 32: Report view

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