EMOS® MEMBRANE PROTECTOR

PROTECT YOUR MEMBRANES AND AVOID PLANT PERFORMANCE DECLINE

THE MEMBRANES' ROLE IN ELECTROLYZER EFFICIENCY

Ensuring the longevity and optimal performance of an electrolyzer hinges significantly upon the safeguarding of its crucial component–the membrane. The membrane plays a pivotal role in separating the anode and cathode chambers, facilitating the selective transport of ions while preventing undesirable crossover. Protecting this membrane is paramount for sustained efficiency and safety in electrolysis processes. By shielding the membrane from harsh operating conditions, chemical contaminants, excessive pressure differentials, and temperature extremes, you extend the overall lifetime of the electrolyzer. This preservation of the membrane enhances the efficiency of ion transport, minimizing degradation over time and promoting consistent electrolysis performance. This focus on membrane protection not only extends the lifetime of the electrolyzer but also significantly improves its efficiency, thereby reducing operational costs and environmental impact.

EMOS® Membrane Protector detects faults hours before they occur by evaluating in real-time complex operation rules for the specific process conditions and asset types. Any operating deviation prompts an alarm, which enables operators to plan their intervention before an emergency shutdown is set off.

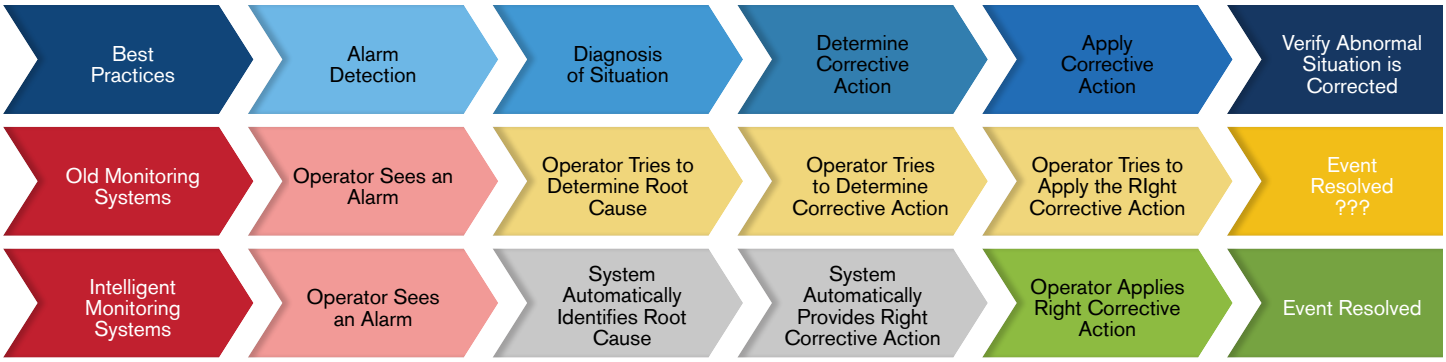
FEATURES	BENEFITS
Early voltage increase detection	Irreversible voltage increase is minimized
Early current efficiency decrease detection	Minimizes Irreversible current efficiency decrease
Alarming of potentially harmful operating conditions	Prevention of accumulation of minor performance losses with time
Explanation of fault	Supports the validation process of the operators
Recommendation of countermeasures	Early application of countermeasures

"WHAT SHOULD I DO WITH THIS ALARM?"

This question raised by operators in control rooms epitomizes a key challenge: preserving the technical know-how and expertise, in a context of experienced workers gradually retiring and young workers joining the industry. There indeed exists an important risk that knowledge might not be fully transferred between seasoned employees and new hires. Moreover, budget cuts sometimes lead to a reduction of staff in control rooms, which means that operators and engineers must now resolve more alarms in less time than before.

MORE MEANINGFUL AND ACTIONABLE ALARMS

This knowledge gap and need for greater efficiency in the control room can be addressed by using more intelligent monitoring systems that offer more meaningful alarms, with actionable information. The procedure to remedy an incident can be broken down in 5 steps as shown below.



Automated Steps = Time Savings!

With older systems, successful incident resolutions depend on operator skills and the time required to carry out each step. However, more intelligent monitoring systems automatically diagnose a situation (root cause analysis) and determine the appropriate corrective action, reducing dependency on operator skill levels, and saving time.

ROOT CAUSE ANALYSIS AND RECOMMENDED CORRECTIVE ACTION

EMOS® Membrane Protector answers these needs by specifying the cause of a hazard for each alarm and by recommending a precise corrective action, providing the following benefits:

- Transform Operators Into Experts
- Shorten Downtime Required to Resolve an Incident
- Increase Throughput Using Fast Fault Resolution
- Reduce Training Time
- Reduce the Number of Incidents Escalated to Shift Supervisors/Engineers by Proposing Corrective Action

EARLY DETECTION OF FAULTS

EMOS® Membrane Protector leverages machine learning to detect faults hours before they occur by comparing, in real-time, the actual cell voltage with the predicted voltage, for the specific process conditions. Any important discrepancy between the two prompts an alarm, which enables operators to plan their intervention before an emergency shutdown is set off. This early detection of faults is unmatched in the industry!

UNIQUE FAULT DETECTIONS: BRINE IMPURITIES

EMOS® Membrane Protector protects electrolyzer plants against many faults such as brine impurities, which are much less reliable and more costly to detect using other vendor equipment. Based on its unique experience of analyzing over 90 000 electrolyser cells worldwide starting more than 30 years ago, R2 has developed best-in-class proprietary algorithms to avoid any abnormal performance loss.

EMOS® MEMBRANE PROTECTOR: PROTECTS EVEN WITHOUT VMS

Contrary to software packages offered by distributed control system (DCS) vendors that address many applications (oil refineries, power plants, etc.) and that require heavy customization, **EMOS® Membrane Protector** comes with built-in root causes and corrective actions for each alarm. Accordingly, you do not have to spend money hiring external engineering firms to configure their “alarm assistance” software. In addition, the membrane Protector does not require any voltage measuring hardware: just a connection of the **EMOS® Membrane Protector** PC to the DCS.

Number of Faults Detected	EMOS Membrane Protector®
Number of Faults Detected	50
Early Detection of Some Faults, Hours Before they Occur	
Single cell voltage measurement	Not required

KEY INCIDENTS DETECTED BY EMOS® MEMBRANE PROTECTOR

The key incidents that **EMOS® Membrane Protector** detects are listed below, as well as their frequency of occurrence and their impact.

Fault	Description	Frequency	Impact
Insufficient brine flow (normal operation)	Low brine flow rate, reducing level in anolyte compartment. Can cause membrane damage.	Often	Severe
Insufficient catholyte flow (normal operation)	Low catholyte flow rate. Increases cell temperature. Might harm the membrane.	Often	Severe
Severe brine impurities	High concentration of impurities in brine, degrading membrane quality through precipitation of hydroxides or sales in membrane. Current efficiency decreases.	Average	Severe
Fast instrument failure	Electrolyzer sensor fails, giving wrong readings. Can cause electrolyzer to operate in inadequate conditions, damaging membranes, cathodes, or anodes.	Average	Severe
Corrosive brine in catholyte mixture	Corrosives from last shutdown still present in brine. Corrosives migrate in membrane, poisoning it.	Often	Severe

FAULTS DETECTED BY EMOS® MEMBRANE PROTECTOR

Operation Mode	Faults Detected		
General fault	• Overload from load increase • Bus bar overheat • Diff pressure electro high • Hydrogen pressure high • Hydrogen pressure low • Outlet temperature high • High membrane tension • Startup with corrosives	• DCS tags not plausible • Reverse pressure electro high • Diff pressure electro high • Diff pressure electro high load • Brine feed temperature low • Brine feed temperature high • Catholyte feed temperature low • Electrolyzer too long in circulation	• Electrolyzer is battery • Electrolyzer temperature too hot • Electrolysis is no flow • Incomplete inerting no flow • Too high low water to catholyte • Sever pinhole startup • Severe pinhole shutdown • Catholyte feed temperature high
Filling	• Severe Pinhole		
Low Load	• Insufficient brine flow • Insufficient catholyte flow • Too Long at low load	• Startup too fast • Electrolyzer temperature too cold • Feed Brine PHT too High during startup	• Catholyte outlet concentration high • Catholyte outlet concentration low
Normal	• Fast Instrument Failure • Insufficient catholyte flow • EDE precision bad • Severe brine impurities	• ACDC conversion efficiency bad • Diff Pressure electro low • Electrolyzer voltage higher than warranty	• Catholyte outlet concentration high • Catholyte outlet concentration low • Plant voltage higher than warranty • Plant current efficiency lower than warranty

SYSTEM REQUIREMENTS

EMOS® Membrane Protector	
Communication	OPC Link with DCS
Membrane Protector will be provided by R2 on a separate PC.	
NOTE: Since computer technologies are constantly changing, please contact us to verify if your existing server can run **EMOS® Advisory**.	

ORDERING INFORMATION

Part Number	Description
----	EMOS® Hardware
SWSTD	EMOS® Safety Software Package
SWSTD	EMOS® Single Cell Temperature Evaluator
SWSTD	EMOS® Pinhole Detector