Case study:

Risks of Cathodic Pressurization in diaphragm cells operating with synthetic diaphragm

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Carbocloro

+

Indupa

Where are we?

1º *Chlorine Production in Latin America*

2º *PVC Production in South America*

Site Office

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Sites:

Cubatão (SP/BR)

Started in 1964
Caustic, Liquid Chlorine and Derivatives
Mercury / Diaphragm / Membrane

Santo André (SP/BR)

Started in 1941
Caustic and PVC
Membrane

Bahía Blanca (BA/AR)

Started in 1981
Caustic and PVC
Mercury / Membrane

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Production Capacity

Plant Capacity (metric ton/year)	CUBATÃO Brazil	SANTO ANDRÉ Brazil	BAHÍA BLANCA Argentina	TOTAL
Chlorine	355,000	160,000	165,000	**680,000**
Caustic soda	400,000	180,000	185,000	**765,000**
Hydrochloric Acid 33%	630,000	115,000	145,000	**890,000**
Soda Bleach	400,000	---	---	**400,000**
EDC	140,000	500,000	400,000	**1.040,000**
MVC	---	300,000	240,000	**540,000**
PVC	---	280,000	240,000	**520,000**

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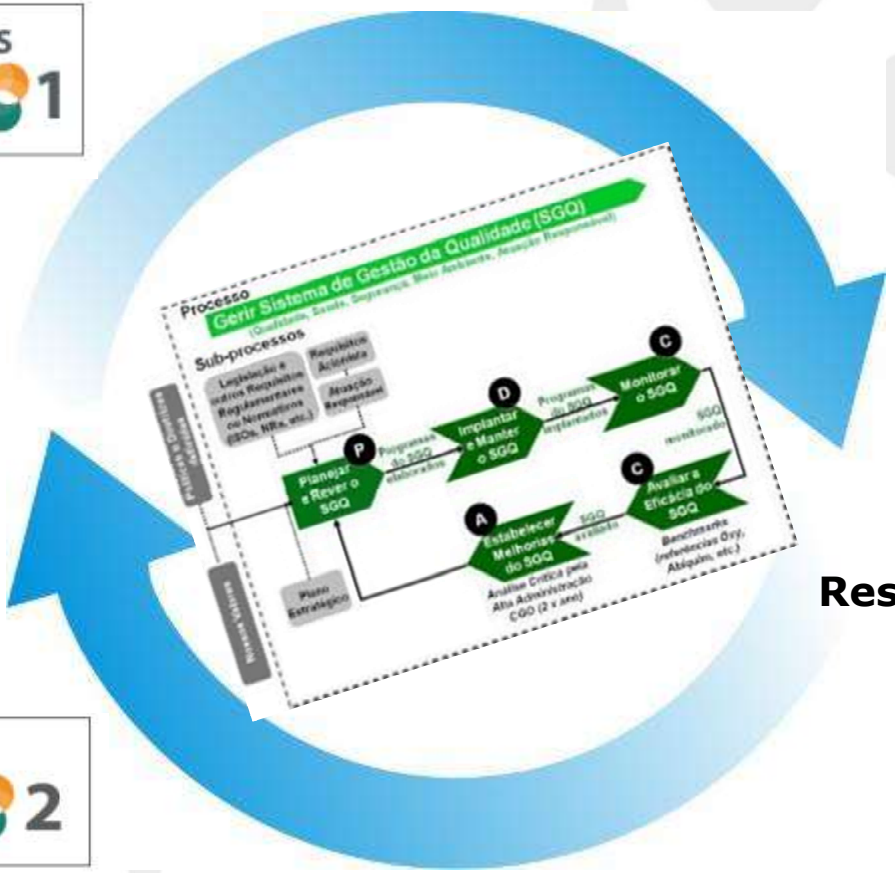
Integrated Management System

2005 OHSAS 18001

1999 ISO 14001

1994 ISO 9002



Responsible Care®
1992

UNIPAR

OPEN GATE PROGRAM

since 1984

34 YEARS

We have already received more than

114.500

VISITORS

ZERO

ACCIDENTS

WITH VISITORS

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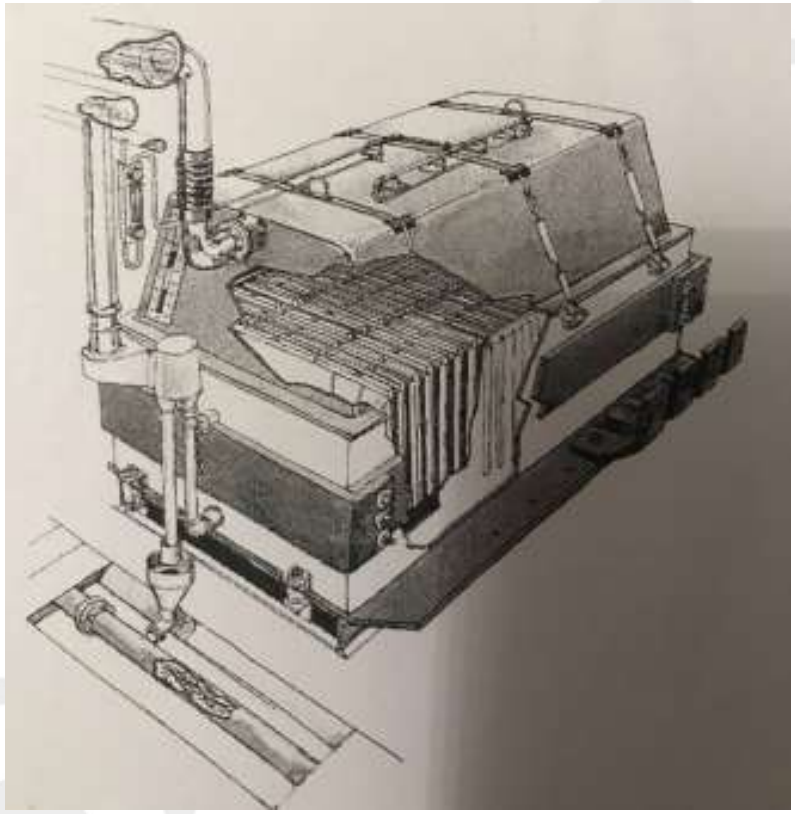
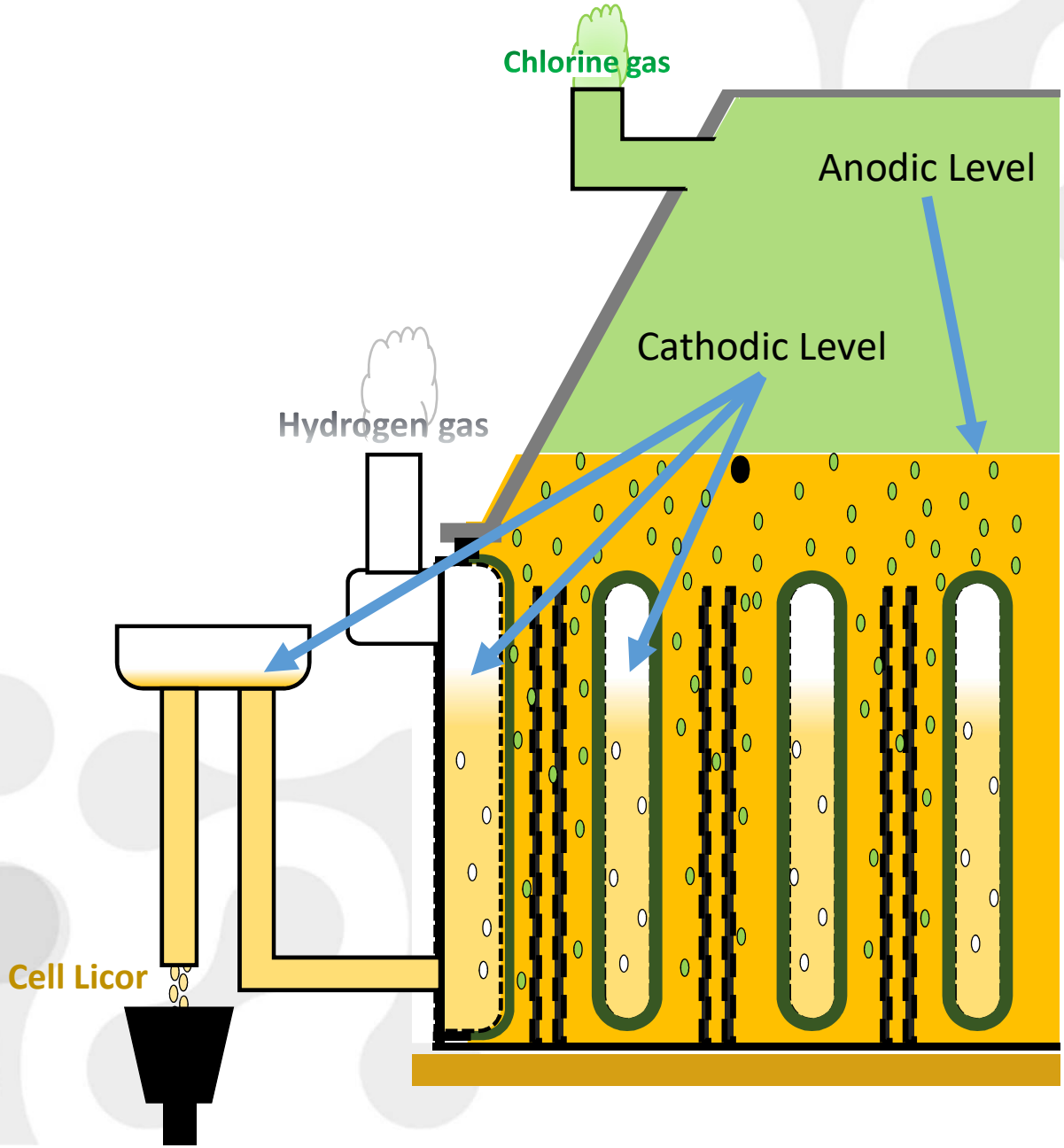
Risks of Cathodic Pressurization in cells with synthetic diaphragm - PMX



Diaphragm cell condition in normal operation



Difference between modified asbestos diaphragm and PMX

Modified asbestos diaphragm:

- *The deposition is done directly on the cathodic screen;*
- *Asbestos fibers cover the entire surface of the cathode;*
- *Can withstand small intensity pressure inversions between the cathodic side and anodic side for a short period of time.*

PMX Diaphragm:

- *To make the deposition a nylon screen is installed on the cathode screen;*
- *The PMX fibers are attached to the nylon screen by not adhering to the cathode screen;*
- *In case of pressure inversions between the cathodic side and the anodic side, even for a short period of time and small intensity, all the resistance stays at the edge of the cathode (looks like a gas balloon);*
- *Due to that it has the risk of blistering or tearing the diaphragm.*

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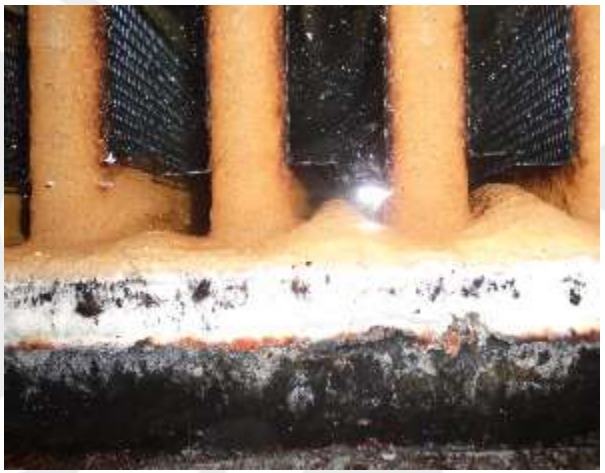
Difference between modified asbestos diaphragm and PMX

A nylon screen is installed on the cathode screen

Tearing the diaphragm at the edge of the cathode



Blistering can occur where the diaphragm is not supported by the anodes

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Difference between modified asbestos diaphragm and PMX

Risk - passing hydrogen to the anodic side

A nylon screen is installed on the cathode
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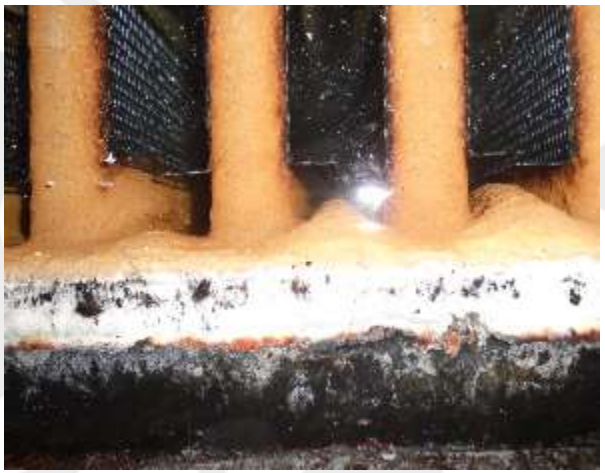
Tearing the diaphragm at the edge of the cathode



Blistering can occur where the diaphragm is not supported by the anodes

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Possible reasons of pressure inversion between cathodic and anodic sides

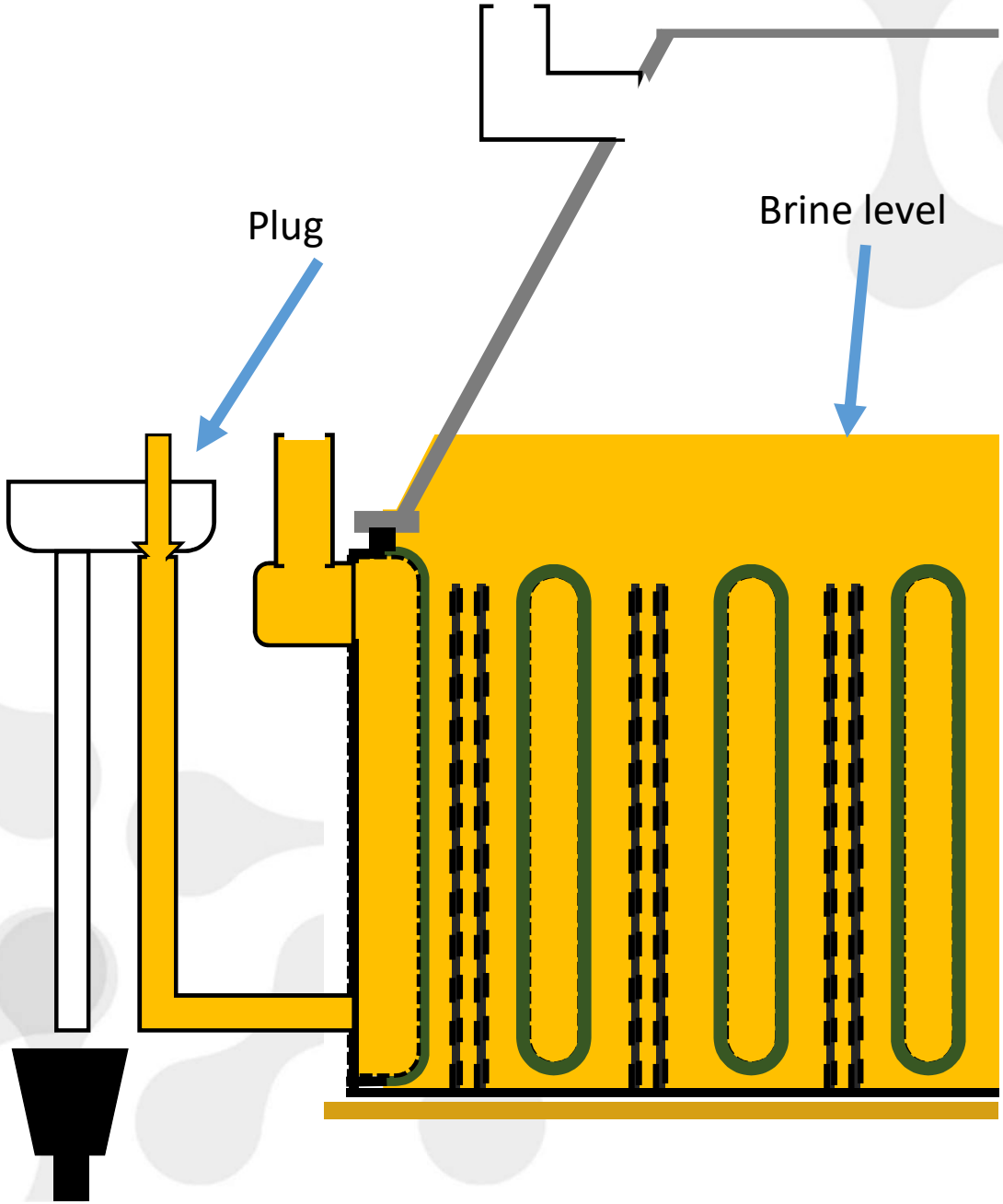
During cell startup:

- *Not draining the internal liquor sufficiently of the cathode;*
- *Failure during hydrogen hose installation.*

During normal operation - excessive vacuum in the chlorine system:

- *Excessive water flow to the chlorine seal;*
- *Failure to drain the sealing water from the chlorine seal.*

Normal diaphragm cell startup

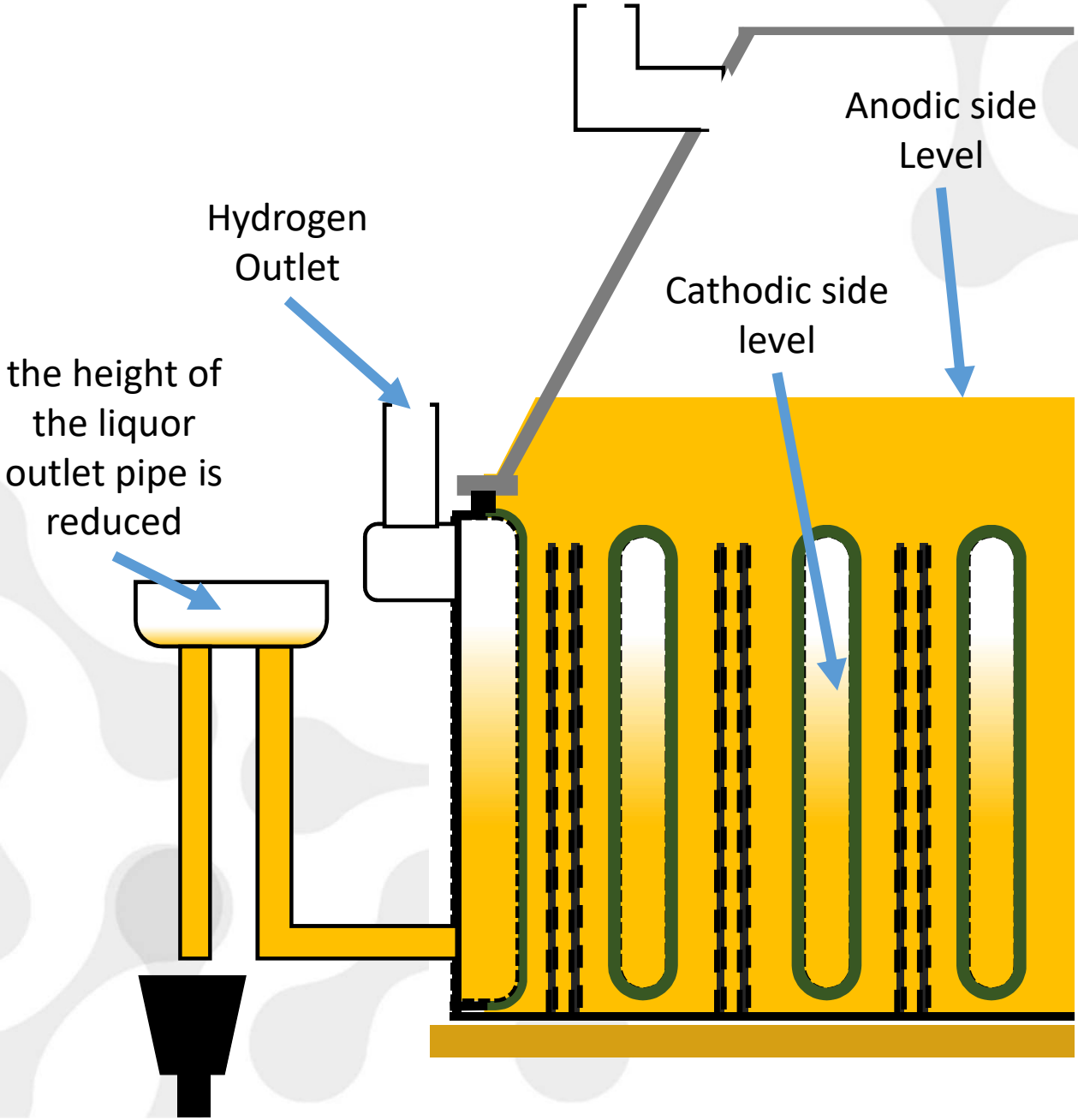


Diaphragm cell condition during a long stop:

When the cells are out of operation, a plug is installed in the liquor outlet.

Due to that it is possible to ensure that the entire cathodic area is kept full of brine, preventing corrosion of the cathodic screen.

Normal diaphragm cell startup



In the startup preparation, the plug is withdrawn and the height of the liquor outlet pipe is reduced, creating different liquid levels in the anode and cathodic sides.

Thus to that the pressure within the cathode region is slightly lower than the pressure of the anodic region.

As the entire diaphragm is sealed with brine the hydrogen will be directed to the specific outlet as soon as the cell is energized.

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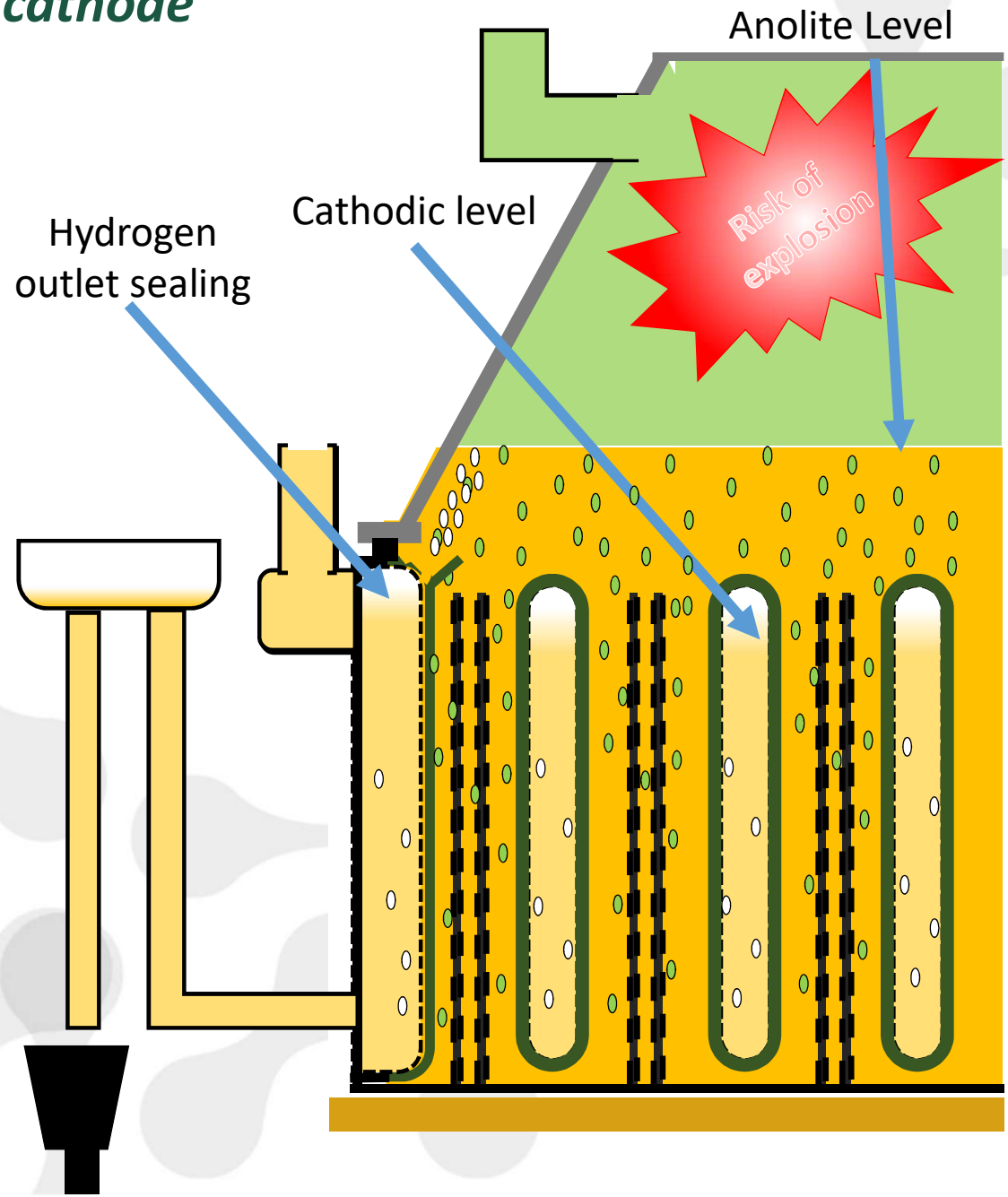
Failure during cell startup: *Not draining the internal liquor sufficiently of the cathode*



If the cell is switched on before sufficient amount of brine is drained from the cathode side, there will be a pressurization due to the sealing of the hydrogen outlet.

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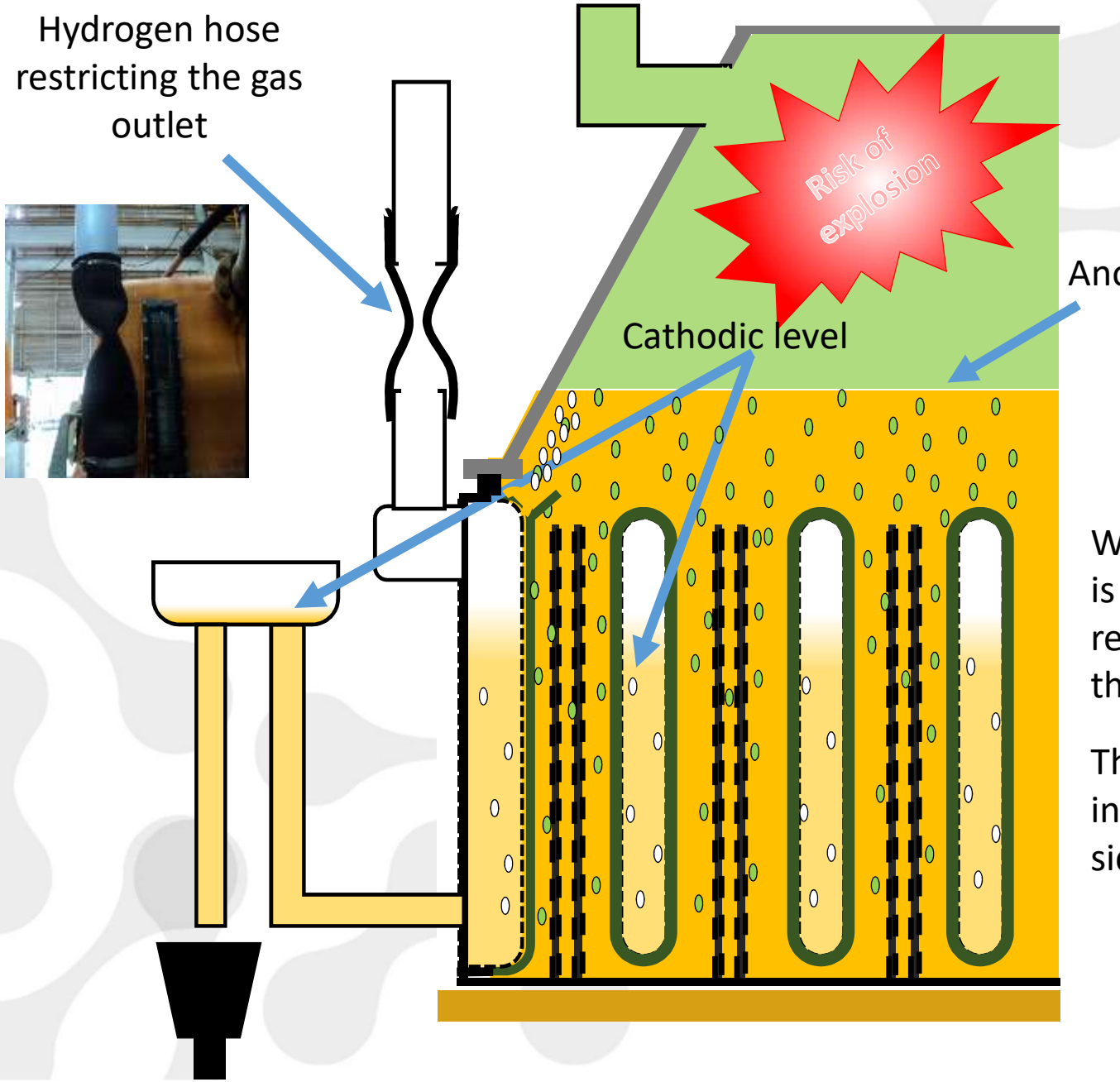
Fail during cell startup: Failure during hydrogen hose installation

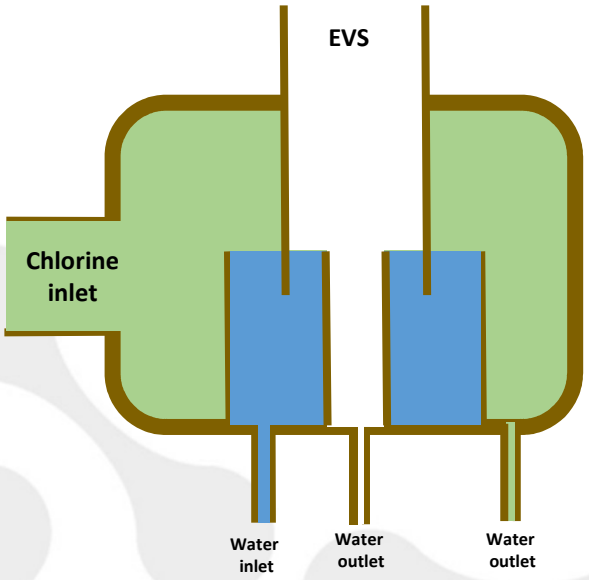


When the hydrogen hose is installed there may be a restriction that will block the gas outflow.

This will cause an pressure increase on the cathode side.

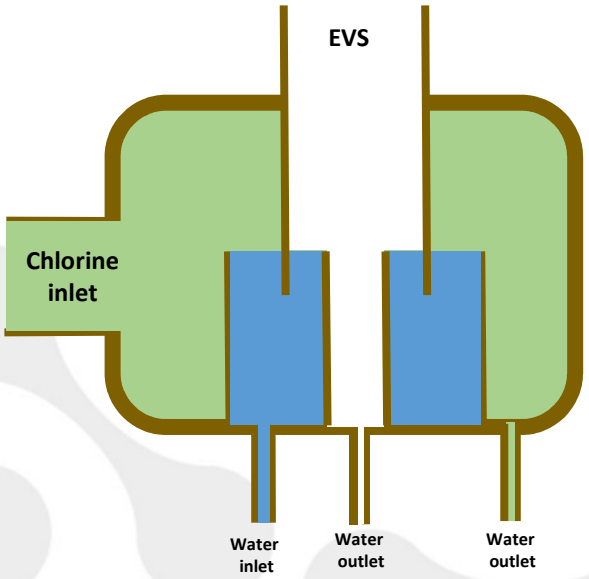
Chlorine seal – Controls the maximum or minimum pressure in chlorine header

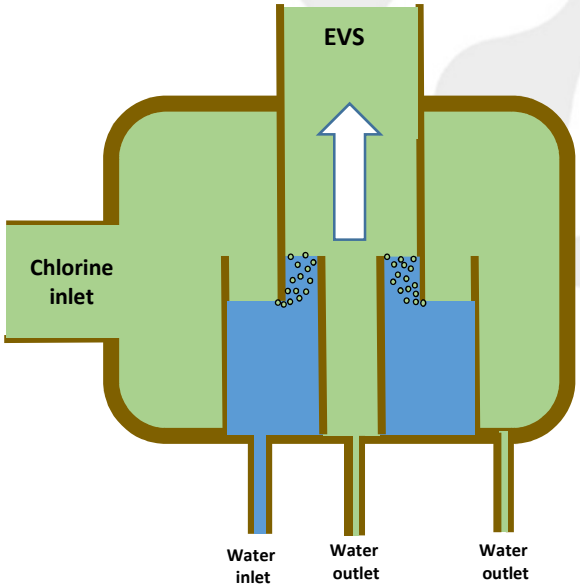
No pressure in chlorine header



Chlorine seal – Controls the maximum or minimum pressure in chlorine header

No pressure in chlorine header

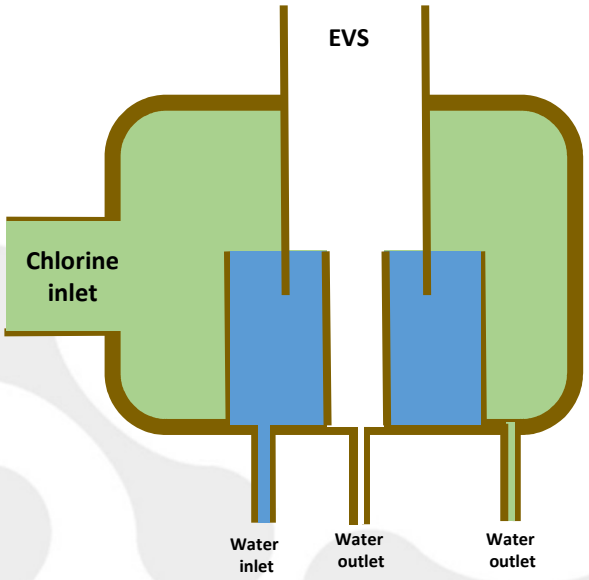


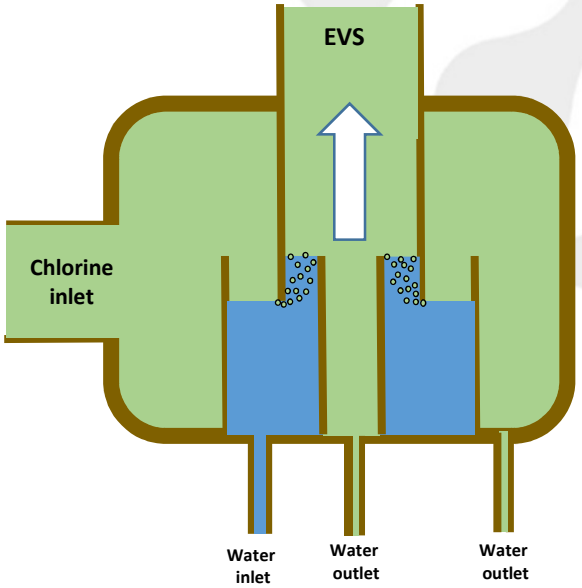


High pressure in chlorine header

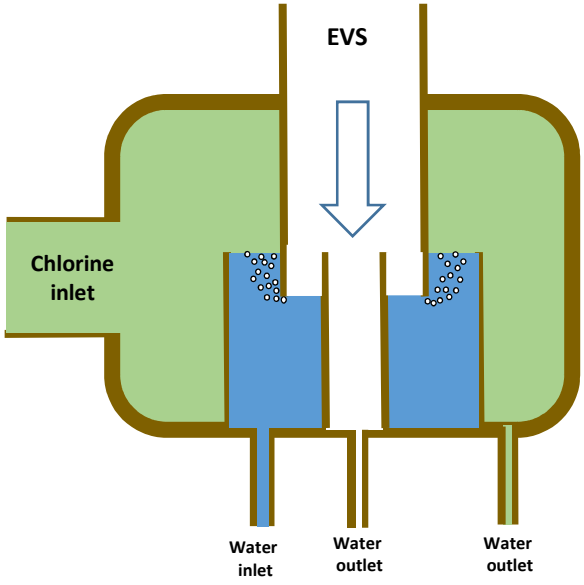
Chlorine seal – Controls the maximum or minimum pressure in chlorine header

No pressure in chlorine header





High pressure in chlorine header



Low pressure in chlorine header

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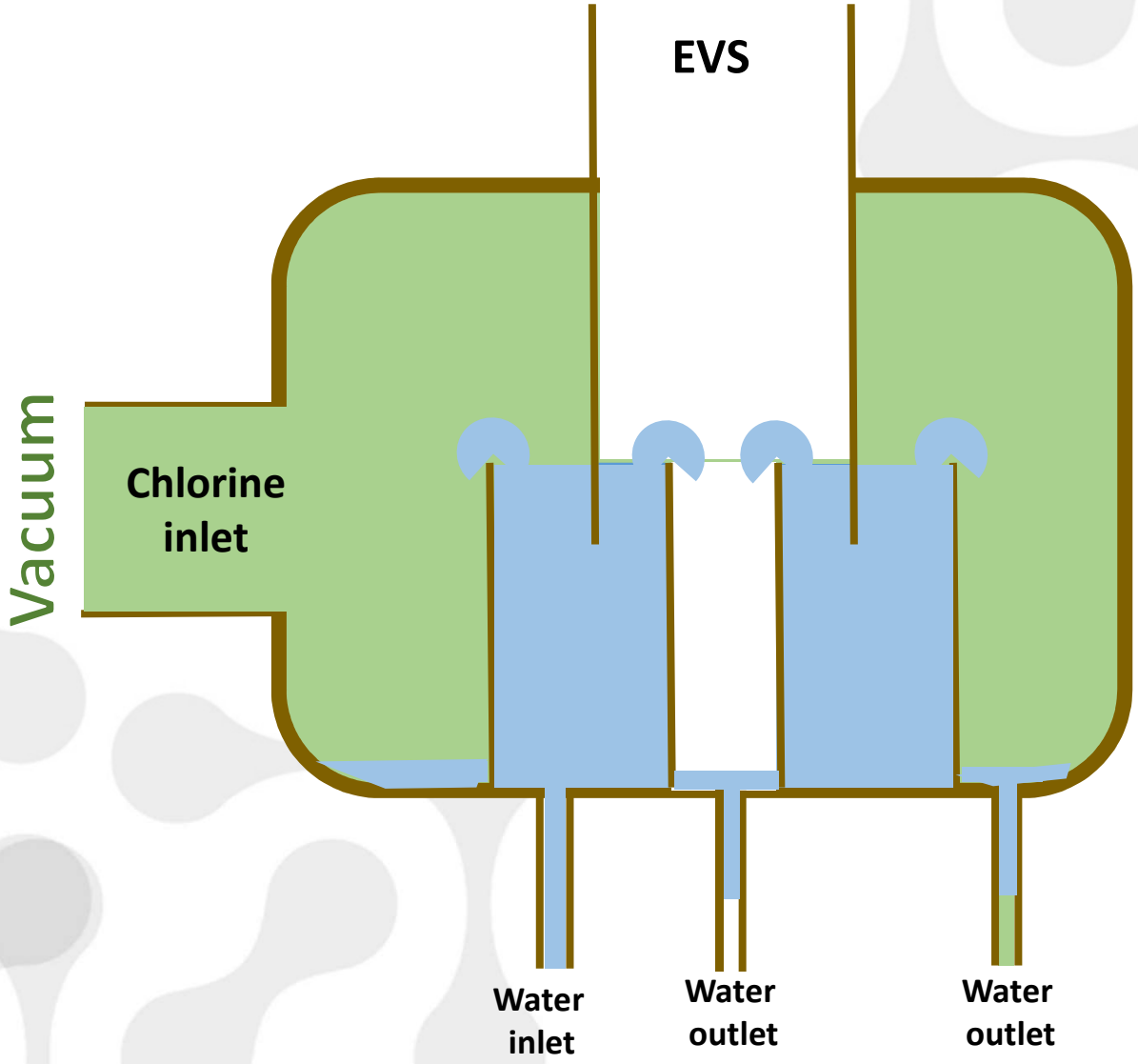
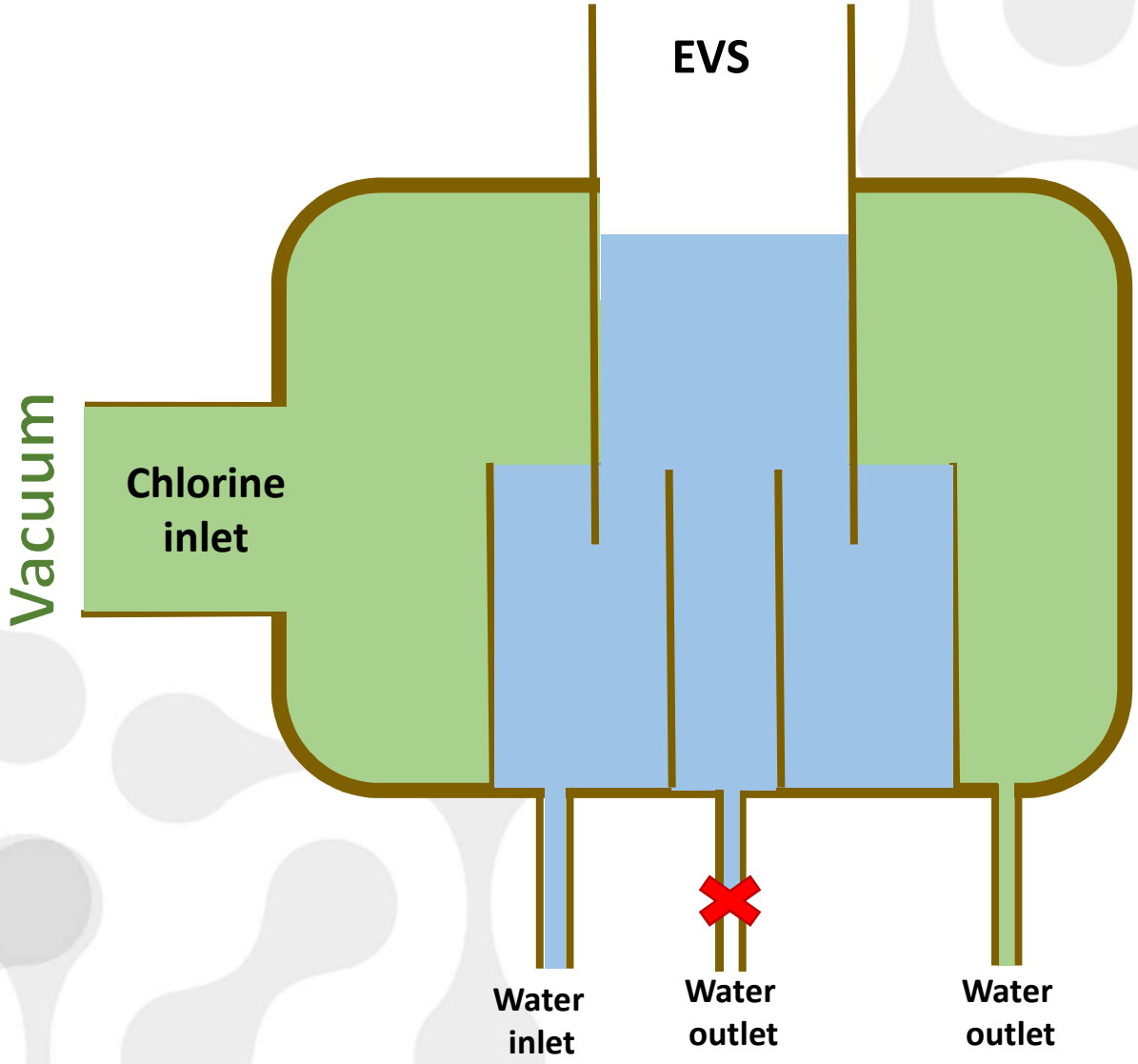
Excessive vacuum in the chlorine system:

Excessive water flow to the chlorine seal



Excessive vacuum in the chlorine system:

Failure to drain the sealing water from the chlorine seal



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