



AI Enhanced Ozone Production for more Efficient Bleached Pulp Production



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Ozone

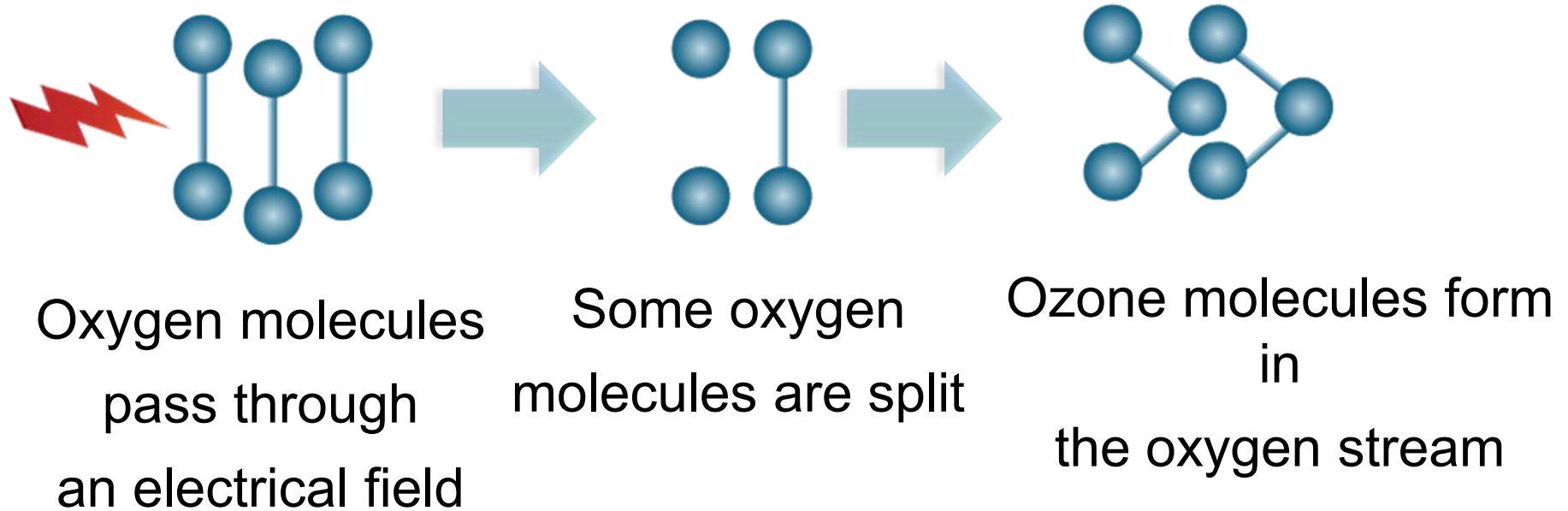
Ozone is a reactive gas:

- Formed by three oxygen atoms
- With a strong oxidizing power
- Unstable, it decomposes into oxygen and cannot be stored. It must be produced at site
- Smelly and detected by the human nose at 0.01 ppm concentration (work is allowed during 8 hours at 0.1 ppm concentration)

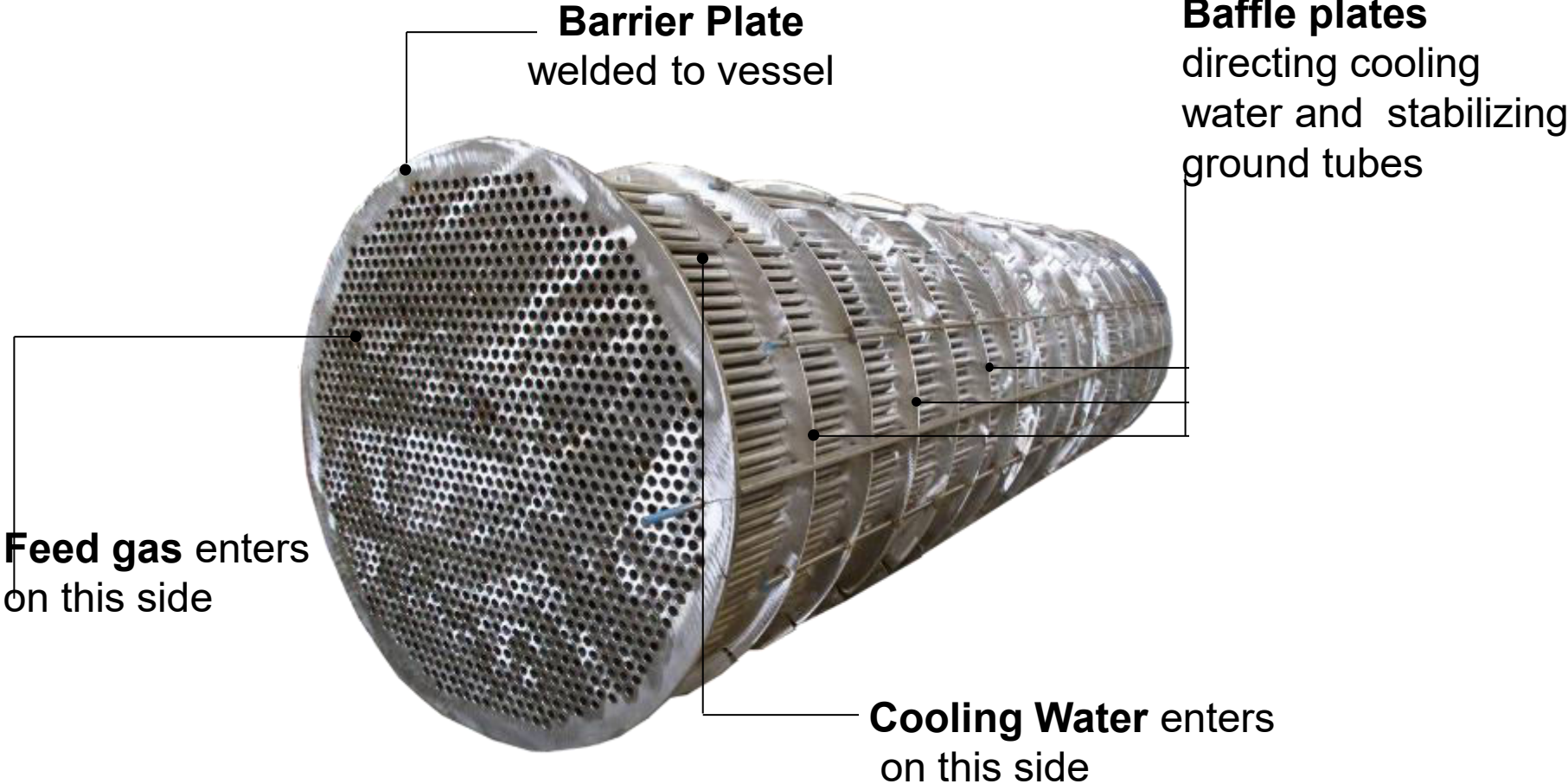
Ozone Production

Ozone production requires:

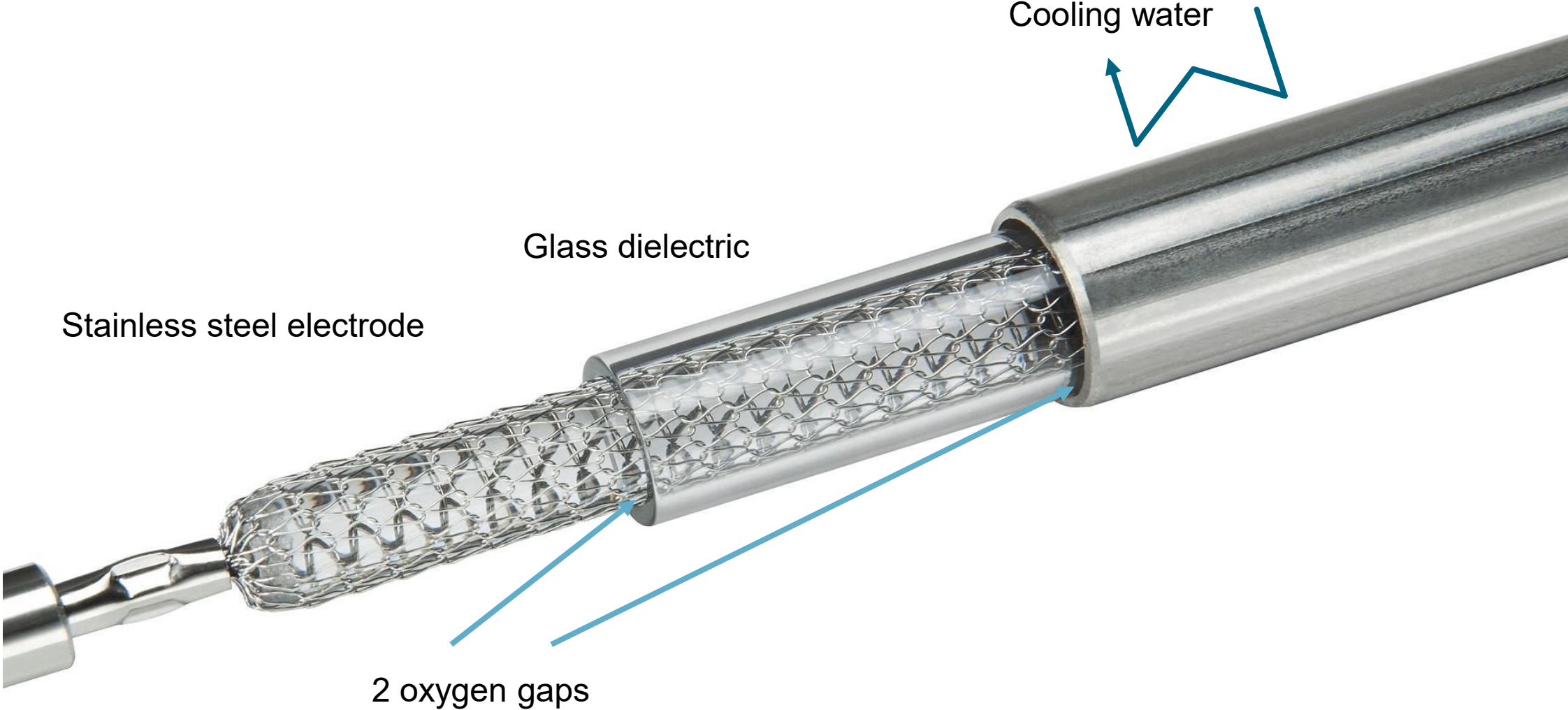
- Electricity
- Oxygen
- Cooling water



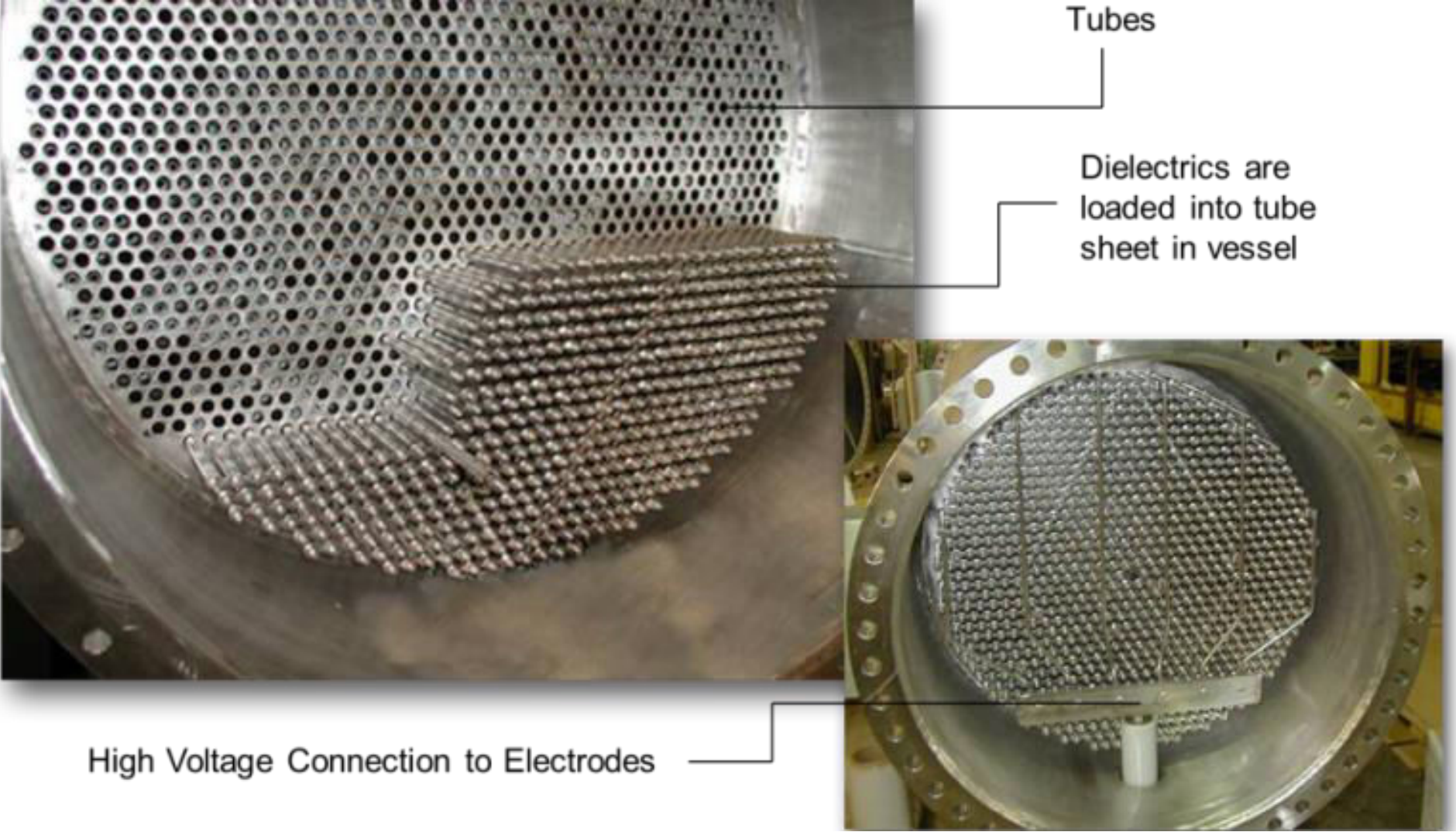
Generator Vessel



Wedeco Patented Electrode Technology



Generator Assembly



Ozone Generator & Power Supply Unit



Ozone Generation and AI

Ozone technology is mainly a question of fluids (gas and water) and electricity management. Xylem released at the end of 2024 its new ozone generation technology. It offers 5% lower electricity consumption to pulp producers than the earlier generation, already the market leader.

This new development is partly the result of the use of AI-enhanced tools: AI was used to improve design of the cooling water flow after using CFD (Computational fluid dynamics) tools.

Monitoring Elements – Example of the Oxygen Line

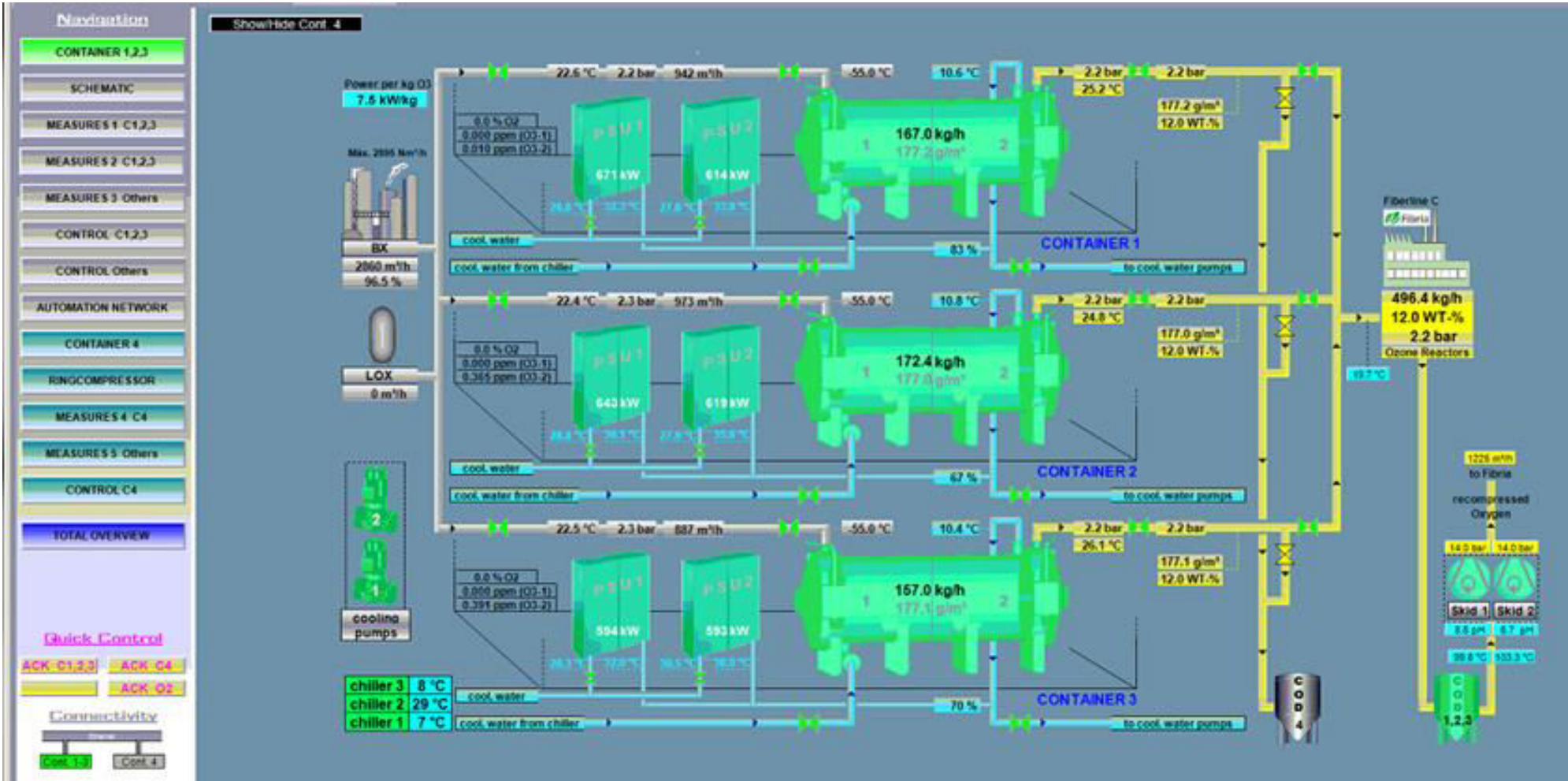


Monitoring Elements – PLC

The PLC checks the following functions:

- gas flow parameters (pressure, temperature, dew point, ozone concentration)
- ozone concentration
- produced ozone mass
- ozone generation unit parameters (power, frequency, voltage, temperature, etc.)
- ambient air measurements
- cooling water flow and temperature

PLC Interface – Example of a 3 Generators Installation



Integration to Mill DCS

The mill DCS automatically adjusts ozone generation to:

- a selected bleaching parameter setpoint measured online (Kappa number, viscosity, or brightness)
- residual ozone concentration in the off-gas
- or with a special supervisory program optimizing chemical costs and final bleached pulp quality.

The latter solution can use AI, especially with machine learning and data analysis.

Ozone Vitals

The screenshot displays the Xylem Ozone Vitals interface. At the top left is the Xylem logo and the text "Ozone Vitals". At the top right are links for "Stations", a notification bell, and a user profile icon. Below the header, there is a navigation bar with a back arrow and the text "Back to the list of stations" on the left, and a "Comments" button on the right. The main title is "Ozone Customer 1". Below the title, there is a warning banner with a triangle icon and the text "Attention needed", followed by a breadcrumb trail: "PreProcessedData > XGatewayOzone1". On the right side, it says "Reviewed by: OzoneV1, 15:40 | Jan 13, 2025". The main content area has a maintenance message: "Maintenance message: Feed gas dew point above ideal level. Further increase creates risk of electrode damage. Check feed gas, supply lines and dryer / compressor." Below this message is a navigation bar with three tabs: "Data", "Report" (which is selected and highlighted), and "Station Info". Below the navigation bar, there is a date and time selector showing "Jan 13, 2025, 16:16:17", a calendar icon, "UTC +00:00", and a "Now" button. Below the selector, a note states: "The analysis is based on data from 1 day leading up to the selected date and time." At the bottom, there is a "Maintenance Message" section with a key icon, the heading "Maintenance Message", and the text "messages: Feed gas dew point above ideal level. Further increase creates risk of electrode damage. Check feed gas, supply lines and dryer / compressor."

Ozone Vitals



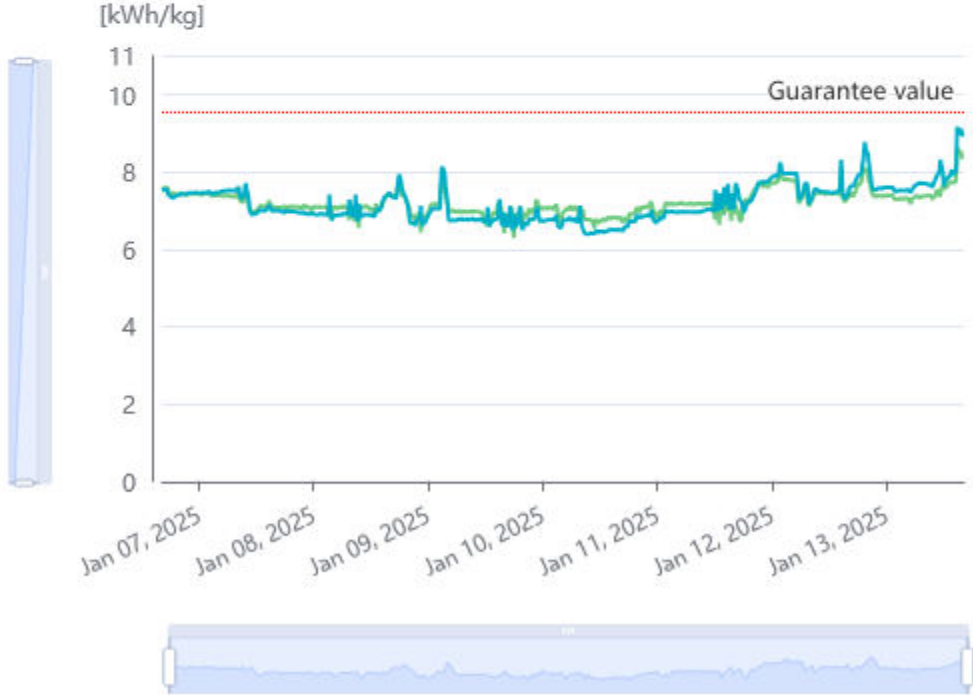
Ozone Production

Ozone Production

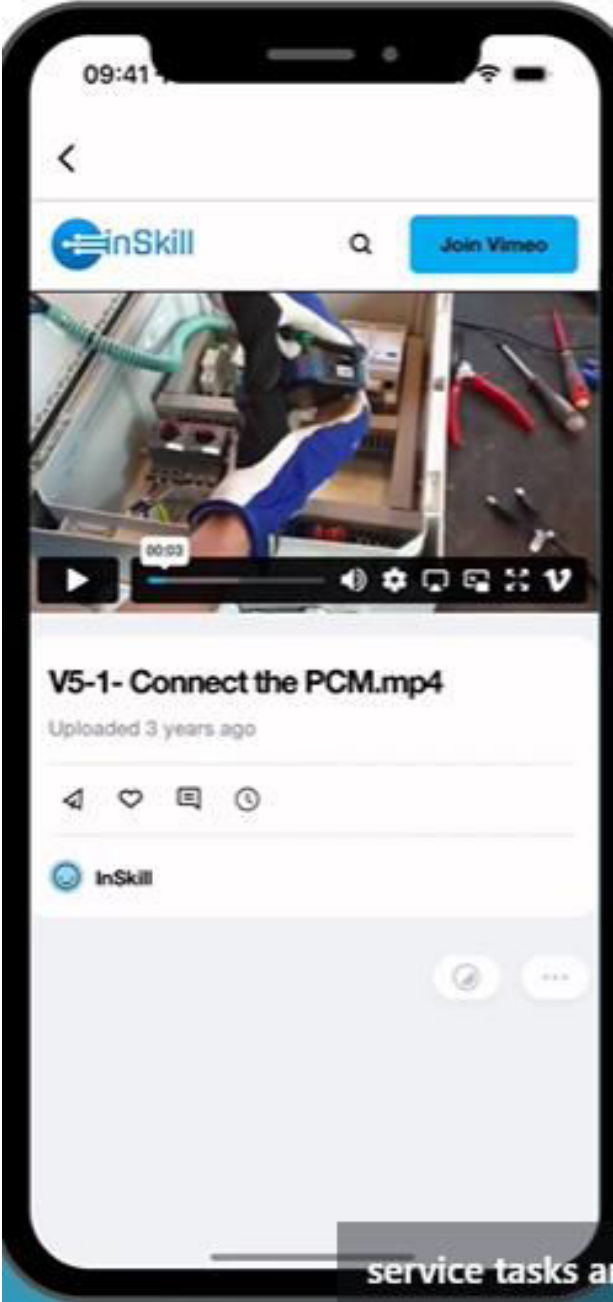


Specific Energy

Actual Rated



Maintenance Copilot



Why the Choice of Ozone

It is well-known ozone chemistry is complementary with those of oxygen, chlorine dioxide and hydrogen peroxide:

I	II	III
Active on any phenolic group and C=C	Active on free phenolic groups and some C=C	Active on C=O
Cl ₂	ClO ₂	ClOH
O ₃	O ₂	H ₂ O ₂

But which precise reactions take place is difficult to characterize.

In the future AI-enhanced chemical reactions simulators will help to better understand pulp bleaching chemistry. There is still development work ahead on this topic: AI is a tool that needs to be trained.

Conclusions

AI has been successfully implemented to:

- improve ozone production technology
- enhance the cost of the bleaching chemicals mix for the desired pulp quality by adjusting on real time the dosing of bleaching chemicals

In the future, AI will also help to improve maintenance efficiency and better understand pulp bleaching chemistry.

Today is the beginning of a new revolution that will make the pulp and paper industry even more profitable and sustainable.



Thank You

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