

Control of Golden Mussel by Ozonation of Cooling Water in Power Plants

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Hydroelectric Power Plant Itaipu

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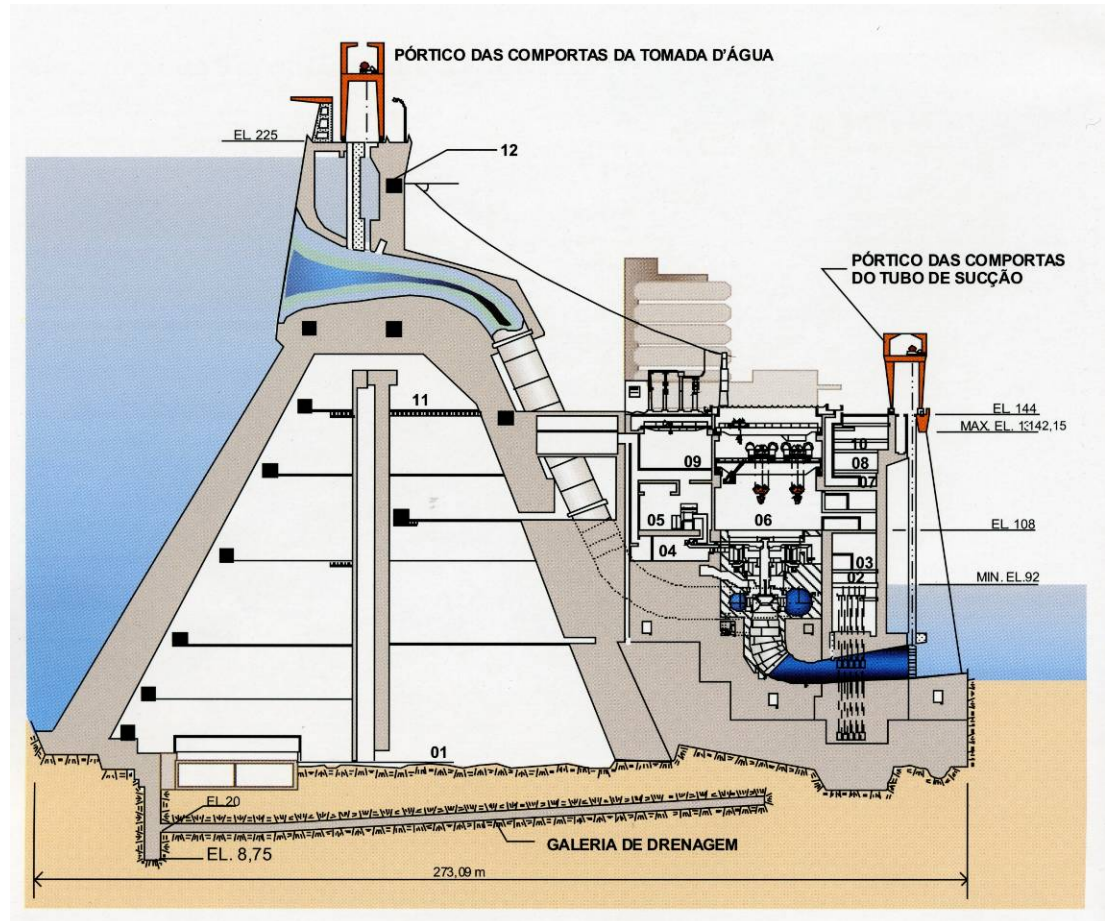
- bi-national project between Brazil and Paraguay
 - 1.350 km² surface reservoir, drainage area of 820.000 km²
 - 20 Francis-turbines with following data, each:
 - 715 MW capacity
 - 125 m altitude difference
 - 660 m³/s water flow



Profile of the Dam

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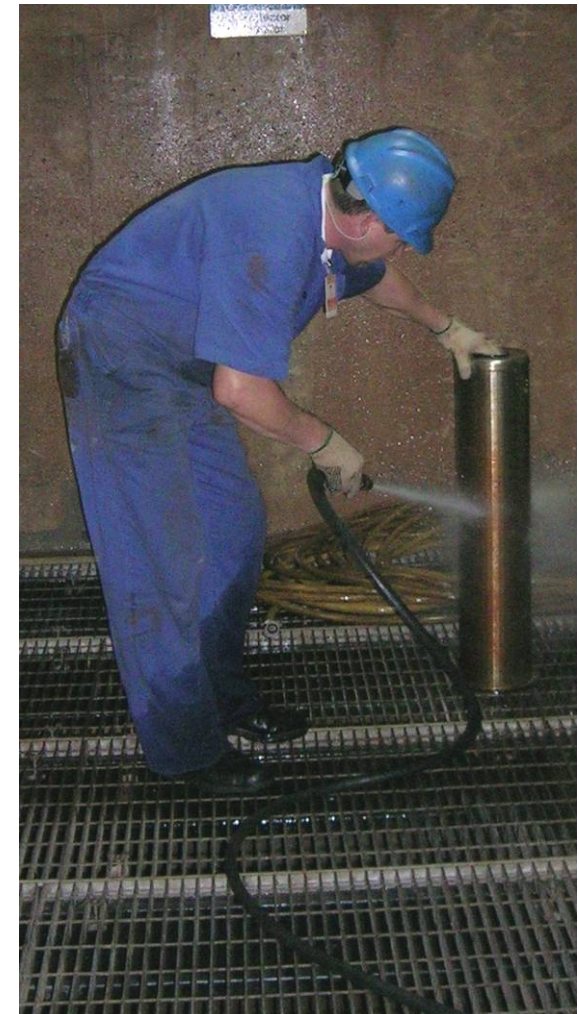
- bypass with 2.253 m³/h for use as cooling water
 - stainless steel cartridge filter, mesh size 2 mm
 - distribution on 11 blocks of heat exchangers



Problems Caused by Mussel Growth

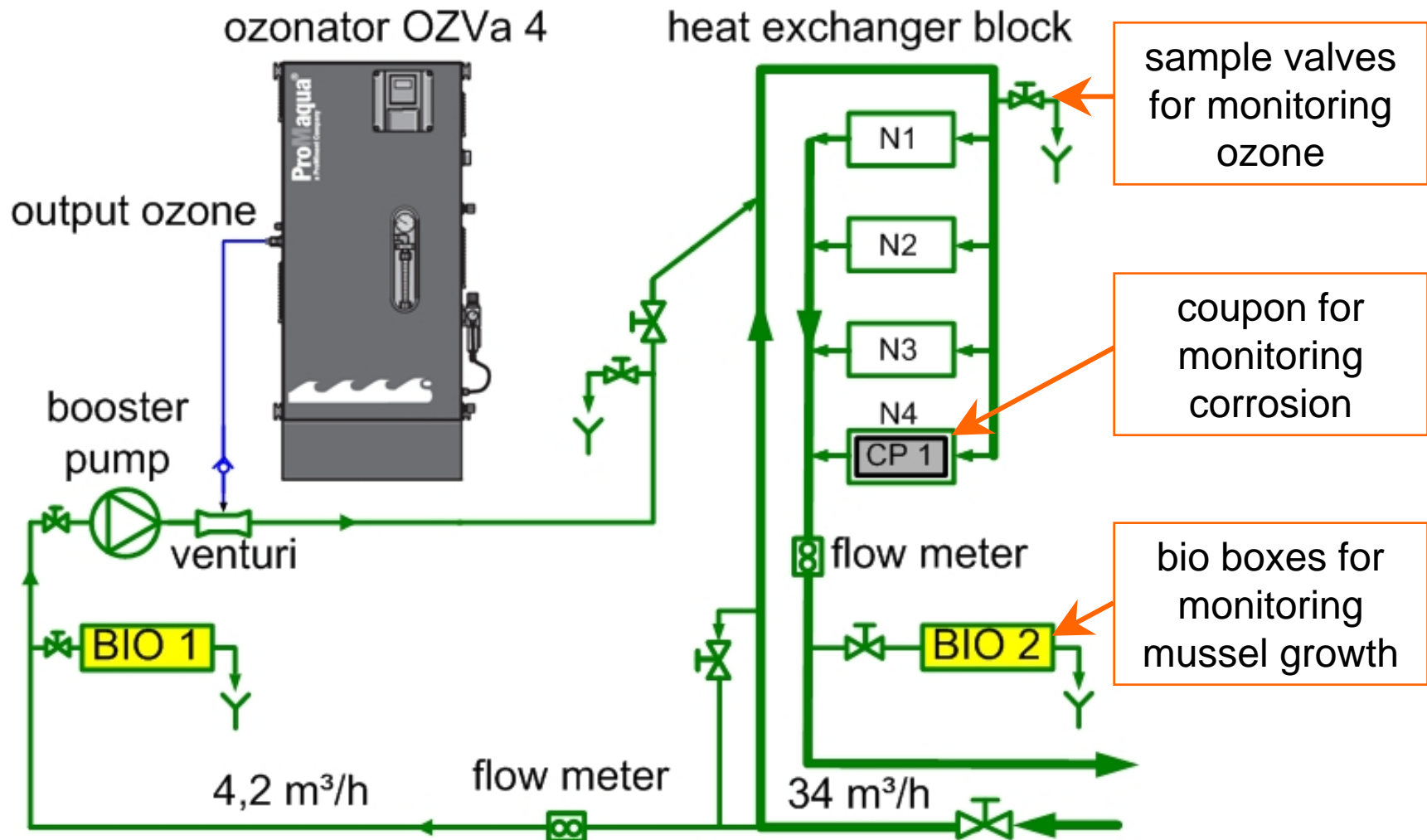
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- growth of *Limnoperna fortunei* (Golden Mussel) on every wetted surface, even at 12,5 bar
 - blocked central filter
 - blocked heat exchangers
- frequently interruptions of the generators to clean filter and heat exchangers



Treatment of One Cooling Circuit with Ozone

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Procedure of the Trial

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- ozonation
 - dosage rates: 0.1, 0.2, 0.3, or 0.4 ppm (calculated on 34 m³/h)
- measurement of the ozone
 - ozone detectable directly after the dosing point
 - no ozone detectable at the heat exchangers
- visual check of the heat exchangers after 3 month
- bio boxes
 - microscopic determination of plastic plates to identify dead and alive veligars
 - 5 pairs of plates allow 5 tests / period
- corrosion coupon test at the heat exchanger
 - incubation period: 87 days



Results: Visual Control of the Heat Exchanger

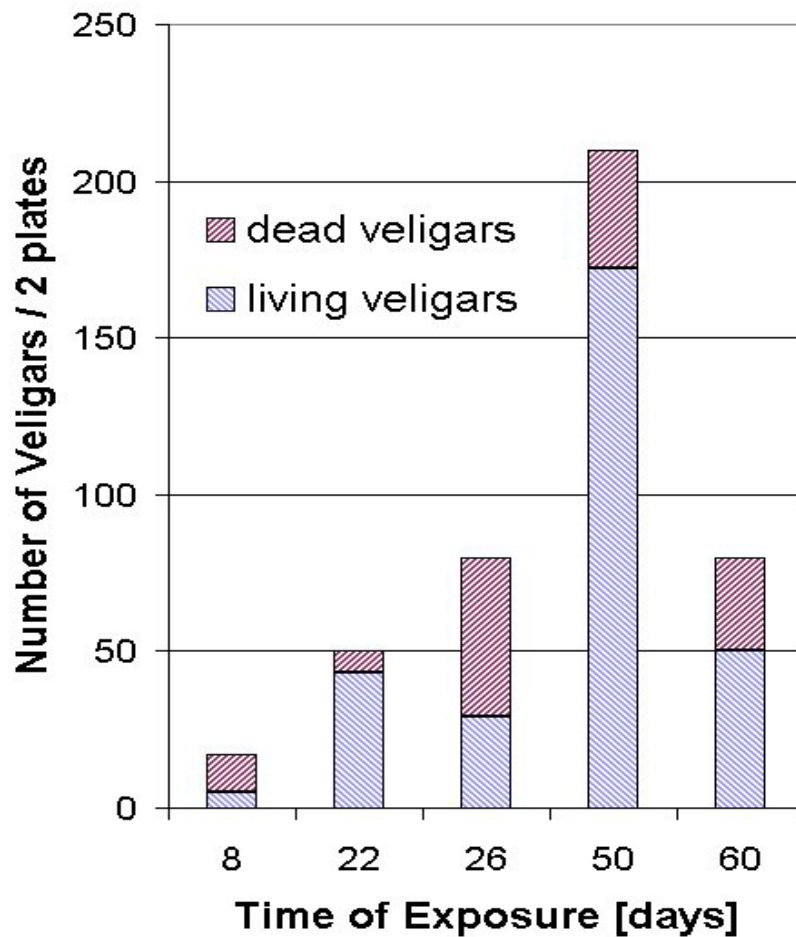
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- 3 month after last cleaning without ozonation
- 3 month after last cleaning with ozonation

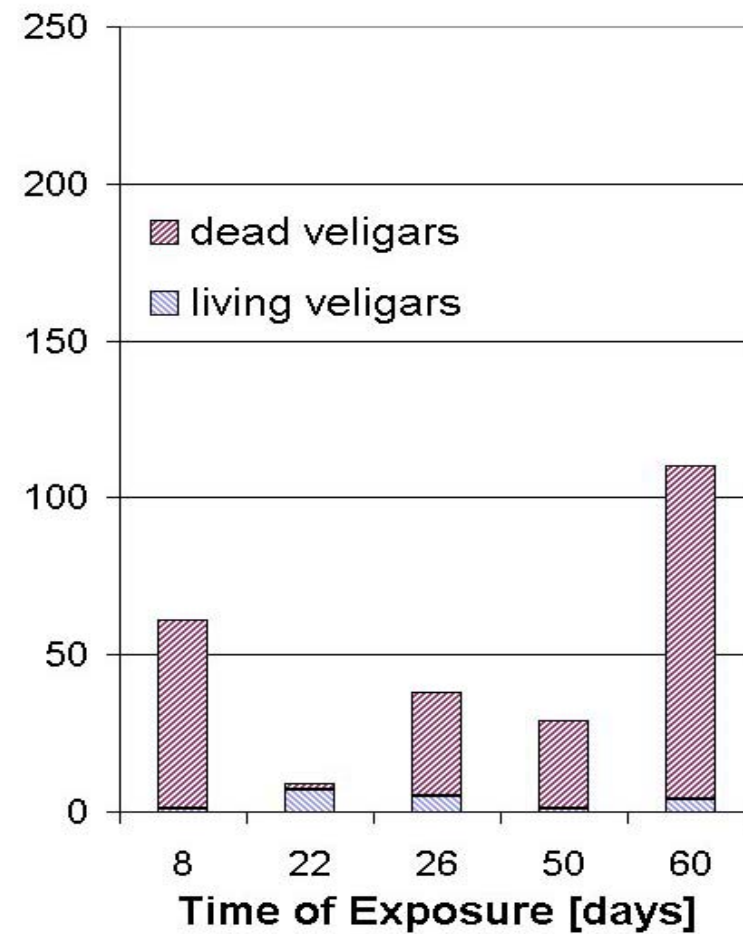


Results: Bio Boxes

- bio box 1:
 - before ozonation



- bio box 2:
 - after ozonation (0,3 ppm)



Results: Corrosion Coupon

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- no corrosive effect of the ozonation detectable
 - determination of general corrosion following international standard ASTM D2688-94
 - incubation period: 87 days
 - corrosion rate: 0,3 mpy (mpy = mils per year)
 - 0 to 2 mpy = excellent
 - 3 to 5 mpy = good
 - 6 to 10 mpy = acceptable
 - > 10 mpy = unacceptable



Summary

- low dosage of ozone in natural river water avoids mussel growth in cooling water circuits
- ozonation is a very ecological water treatment
 - no precursor chemicals required (just oxygen or ambient air)
 - reaction in the water back to oxygen
- ozonation is a very economical water treatment
 - dosage of 0,3 ppm ozone = approx. 1,- €/ 1.000 m³
- complete cooling water of a first turbine in Itaipu is outfitted with ozonation quite now

Thank you for your attention

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Any question?