

Energy calculations

- Ozonation:

- Calculation of required ozone and hydrogen peroxide dose
- Energy requirement for ozone production (15 kWh/kg), hydrogen peroxide production (10 kWh/kg)
- Example: O₃ dose of 1 mg/L = 1g/m³ => 0.015 kWh/m³

- UV/H₂O₂

- Energy required for hydrogen peroxide production
- Determination of required fluence

$$H_{\lambda}'^{avg}$$

$$H_{\lambda}'^{avg} = S_{\lambda} \times H_{\lambda}' = \frac{1 - 10^{-A_{\lambda}}}{2.303 A_{\lambda}} H_{\lambda}'; \quad H_{\lambda}' = H_{\lambda}'^{avg} / S_{\lambda}; \quad S_{\lambda} : \text{correction factor for matrix}$$

$$A_{\lambda} = a_{\lambda} \times l^{avg} \quad A_{\lambda} : \text{water absorption}; \quad a_{\lambda} : \text{absorption coefficient}; \quad l : \text{average pathlength}$$

Energy for x % degradation of compound in kWh/m³:

$$3.6E6 \text{ J} = 1 \text{ kWh}$$

$$E_{lamp} = \frac{H_{\lambda}'(x\%)}{I^{avg} \times \eta_{UV}} \times \frac{\text{kWh}}{3.6 \times 10^6 \text{ m}^3}; \quad \eta_{UV} : \text{efficiency of lamp, typically 0.3}$$

Energy requirements for UV/H₂O₂ typically 5-20 higher than O₃/H₂O₂