Waste water decoloration with ozone

Author:
Marco Rosner
Sales Engineer
WEDECO Umwelttechnologie GmbH
Boschstraße 6, D-32051 Herford
Tel.: +49 / 5221/ 930-261
Fax: +49 / 5221/ 930-249
email: marco.rosner@wedeco.net

Abstract

Due to new government restrictions for the discharge of colored water and the increasing discharge costs of waste water ozone oxidation for decoloration is becoming more and more popular. The effected industries are companies producing textiles, dyes, paper or chemicals.

Additional to the very successful results in decoloration, ozone brings further benefits like desinfection, improved BOD/COD-ratio, reduced AOX and reduction of odour.

Waste water or recycling water can be treated in an environmentally-friendly way without any residuals or concentrates by using ozone.

figure 1: decoloration during a lab test
(waste water of dye industry)

The design of decoloration systems with ozone depends mainly on the color causing compounds and on the COD background load in the water. Because of the chemical structure of colors the ozone reaction takes place within a few minutes whereas the reaction for the reduction of COD can take up to several hours. But nevertheless there is a close relationship between the ozone demand for decoloration and the COD concentration. Simply expressed as higher the COD in the rawwater as higher the ozone demand will usually be.

In the past the following general design parameters could be observed:

Ozone dosage: for COD < 200 mg/l = 25 – 80 g/m³
for COD > 200 mg/l = 50 – 500 g/m³

Retention time: varies between 5 – 30 minutes

If the rawwater contains a high COD concentration a biological pretreatment is recommended prior to ozonation to reduce the COD to a level as low as possible. Based on this the ozone demand for decoloration can be reduced drastically.

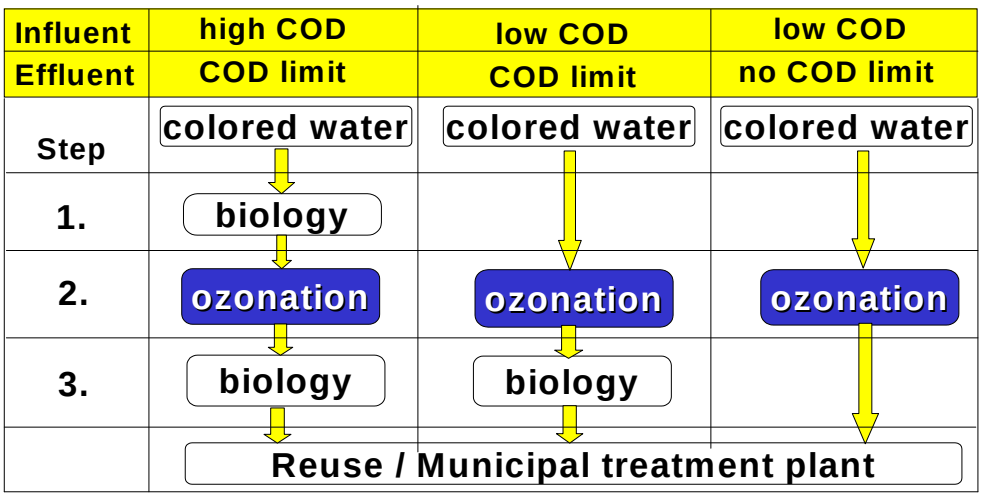

figure 2: Different examples for decoloration with ozone

Competetive technologies for decoloration are:

Technology	Advantages	Disadvantages
Adsorption (activated carbon)	- low invest costs	- high operating costs - no process control - blocking possible
Flocculation	- low invest costs	- high amount of sludge - high control demand - chemical consumption
Membrane	- seperation of selected molecules	- high operating costs - concentrate - blocking membranes - high spare part costs
Evaporation	- no water discharge	- condensate / ash - high operating costs - high invest cost

Table 1: competetive technologies with advantages and disadvantages

Summary

- A single biological treatment step is often not sufficient to reduce color from a certain wastewater as far as demanded by government restrictions or recycling qualtity.
- Ozone is very efficient to eliminate color due the nature of many dyes (double bonds, chromophor groups, etc.)
- The specific ozone demand depends on the nature of the dye, its concentration, the demanded effluent concentration and the background load of COD and suspended solids.
- Due to the dependence on various factors the range varies between 25 – 500 g/m³ water for a color elimination of > 90 %
- A pre-treatment to reduce COD load as low as possible is recommended prior to ozonation to achieve low ozone consumption levels.
- The necessary retention time for decoloration usually does not exceed more then 30 minutes. This results in small reaction volumes.

Appendix

Explanation:

Units for expression of color concentrations in water:

DFZ [m^{-1}] = **D**eutsche **F**arb **Z**ahl (German color number)
DFZ 620 = blue color
DFZ 525 = red color
DFZ 435 = yellow color
Determination = photometric

ADMI [ADMI] = wide range of wavelengths (most detailed expression)
Determination = photometric

Hazen [Hazen] = represents especially yellowish color. Historical based on treatment of drinking water where humic compounds has to be eliminated.
Determination = watersample gets compared to a diluted standard solvent

The values of the mentioned units are generally not comparable!!

Type of dyes and solubility in water:

Type of dyes	consumption [ton/a]	absorbtion on textile [%]	solubility in water
direct dyes	1200	64 – 96	soluble
reactive dyes	4860	55 - 95	soluble
"Küpen" dyes	770	75 - 95	non soluble
acid dyes	370	85- 98	soluble
acid dyes	370	85-98	soluble
cationic	240	96 - 100	soluble
metall complexe dyes	320	82- 98	soluble
dispersion dyes	1070	88 - 99	dispers soluble
pigments	510	100	non soluble
others	750		

Figure 4: Type of dyes and estimated dye consumption in Germany in 1996