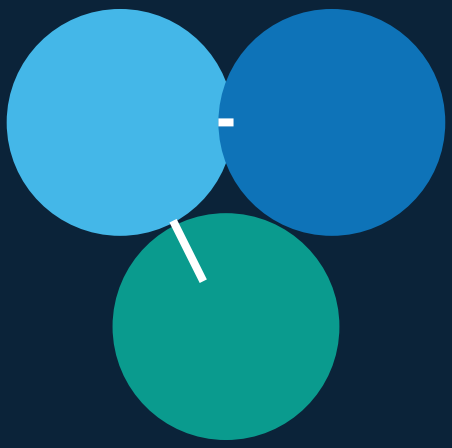
BES GROUP THAILAND

BES KNOWLEDGE SERIES

WHAT IS OZONE?

Professional Engineering Guide



Science • Engineering • Applications • Safety

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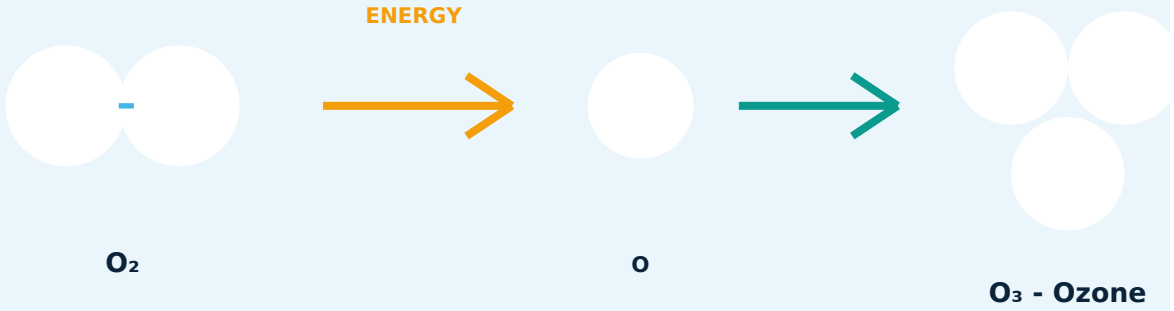
1. What is ozone?

Understanding ozone from science to engineering

Ozone (O_3) is a triatomic form of oxygen. It contains three oxygen atoms rather than the two found in ordinary oxygen (O_2). Because the third oxygen atom is relatively unstable, ozone readily transfers oxygen to other substances. This makes it a powerful oxidizing agent for water treatment, air sanitation, odor control, and industrial processing.

Ozone forms when an oxygen atom reacts with an oxygen molecule.



Why ozone must be generated on-site

Ozone cannot be stored economically for long periods because it naturally decomposes back into oxygen. A treatment system therefore generates ozone at the point of use and immediately transfers it into air or water.

Related: How ozone is generated →

2. Key properties

PROPERTY	ENGINEERING SIGNIFICANCE
Formula	O_3 - three oxygen atoms
Molecular mass	48 g/mol
Appearance	Pale blue gas at sufficiently high concentration
Odor	Sharp, characteristic odor detectable at low concentration
Oxidation potential	Approximately 2.07 V
Stability	Short-lived; decomposes back to oxygen
Storage	Normally generated on-site

Relative oxidation potential

BES Engineering Insight

A higher oxidation potential does not automatically guarantee better field performance. Delivered dose, mass-transfer efficiency, contact time, mixing, water quality, and ozone demand must all be considered.

3. How ozone is generated

Commercial ozone systems use electrical energy to transform oxygen-containing feed streams into ozone. The exact mechanism and feed requirements depend on the technology.

TECHNOLOGY	TYPICAL FEED	ENGINEERING DESCRIPTION
Corona discharge	Dry air / oxygen	Electrical discharge splits O_2; oxygen atoms recombine with O_2 to form O_3.
PEA electrolysis	Suitable water feed	Electrochemical reactions generate ozone for specific aqueous applications.
PEM electrolysis	High-purity water	A proton-exchange membrane cell produces high-purity electrolytic ozone.
AAOP	Ozone + catalyst	Ozone is combined with catalytic or energetic processes to generate highly reactive oxidants such as hydroxyl radicals.

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Technology selection

The correct technology depends on the application, water quality, required ozone purity, dose, flow, operating environment, and maintenance strategy. Product selection should be based on system design rather than output rating alone.

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4. How ozone works

Ozone reacts by direct molecular oxidation and, under suitable conditions, through secondary radical pathways. The dominant pathway depends on pH, temperature, dissolved organic matter, catalysts, and process configuration.

1

Generation

Ozone is produced at the point of use.

2

Transfer

Gas is dissolved into water or introduced into an air stream.

3

Contact

Ozone reaches microorganisms, odor compounds, metals, or organics.

4

Reaction

Target compounds are oxidized or inactivated.

5

Decay

Unused ozone decomposes back into oxygen.

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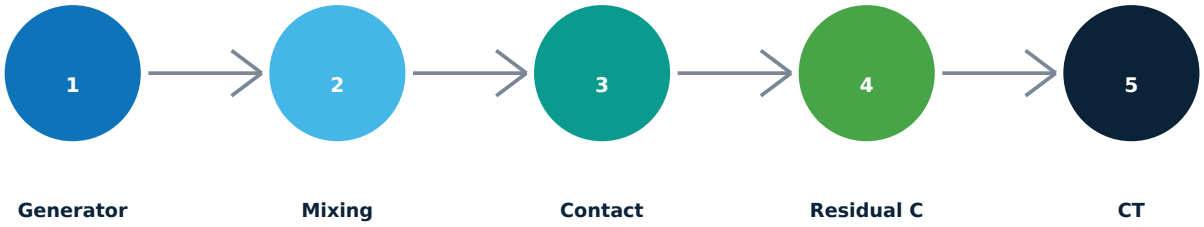
Common misconception

Incorrect: A larger ozone generator always produces better disinfection.
Correct: The result depends on usable transferred dose, hydraulic distribution, ozone demand, residual concentration, and contact time.

5. Engineering design: CT and MTE

Two important engineering concepts are CT and mass-transfer efficiency (MTE). They help distinguish generator capacity from the amount of ozone that actually becomes available for treatment.



CT = Residual concentration × Contact time

CT	**CT = C × T**	Residual concentration multiplied by contact time.
MTE	**Transferred ozone / Generated ozone**	Fraction of generated ozone effectively transferred.
Transferred dose	**Generator output × MTE**	Usable ozone entering treatment.

Illustrative example

If residual ozone concentration is 0.50 mg/L and effective contact time is 2.0 minutes, CT = 1.0 mg·min/L. This is an illustration only; required CT must be selected for the target organism, process condition, and applicable standard.

6. Applications and safety

APPLICATION	TYPICAL OBJECTIVE
Drinking water	Disinfection, oxidation, taste and odor control
Food and beverage	Surface sanitation, wash-water treatment, process hygiene
Swimming pools	Water-quality support, oxidation, chloramine reduction
Cooling towers	Biofilm control support and water-system protection
Wastewater	Oxidation, color reduction, advanced treatment
Air sanitation	Odor and microbial control in appropriately designed systems

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Safety principle

Ozone is a strong oxidant. Systems must be designed to control exposure, prevent unintended off-gas accumulation, and comply with applicable workplace, indoor-air, process, and environmental requirements. Installation and maintenance should be carried out by trained personnel.

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