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Applicability of vaporised hydrogen peroxide for environmental disinfection at healthcare settings

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Introduction

- **Disinfectant for critical areas**: there is no ideal disinfectant.
- Selection requires careful review of numerous factors :

a) type and number of organisms
b) presence of biofilms or organic matter
c) contact time, type of surface and water (hard / soft)
d) efficacy, safety, environmental aspects
e) cost
f) shelf life
g) residual activity.

Hydrogen Peroxide and Mechanism of Action

- Hydrogen peroxide : a disinfectant/sterilant by being applied directly in the form of an aqueous solution at a concentration ranging from 3 to 30% (*w*/*w*)
- Formulated with different chemicals in water or gas, in an aerosolized form or in a vapour form

- Hydrogen peroxide acts as a **strong oxidizing agent**.

- It produces **free radicals (•OH)** that damage:
  - Cell membranes (lipid peroxidation)
  - Proteins and enzymes
  - DNA

- This leads to rapid **cell death of microorganisms**

Spectrum of Activity

- Effective against:
- **- Bacteria** (both Gram-positive & Gram-negative)
- **- Viruses** (especially enveloped viruses like influenza, coronaviruses)
- **- Fungi**
- **- Spores** (only at higher concentrations)

Common concentrations & uses

3% solution

- Household disinfectant
- Wound cleaning (limited use now due to tissue irritation)
- E.g., Blitz clean, Wesol

6–10%

- Surface disinfection in hospitals/labs
- E.g., Boomoxy

>10–30% (vaporized form)

- Sterilization of medical equipment (e.g., endoscopes, ICU surfaces)

Applications

- Disinfecting **surfaces, instruments, and hospital areas**
- Used in **infection control protocols**
- **Vaporized hydrogen peroxide (VHP)** used for room decontamination

Advantages: Hydrogen peroxide solutions

- **Widely available, are inexpensive**, and can **enhance removal of organic matter**

- **Ease of use:** highly effective when used in vapour form as it can easily reach crevices and other hard-to-reach areas.
- **Stability**: stable in water and other formulations, depending on its purity and storage condition
- Broad-spectrum antimicrobial activity
- **Compatibility with surface materials**: when H2O2 is used in vapour form, it is gentle to surfaces and electrical equipment
- Leaves **no toxic residue** (breaks down into water + oxygen)

- **Environmentally friendly**: **non-carcinogenic, non-mutagenic** and has **environmentally safe** by- products (water and oxygen).

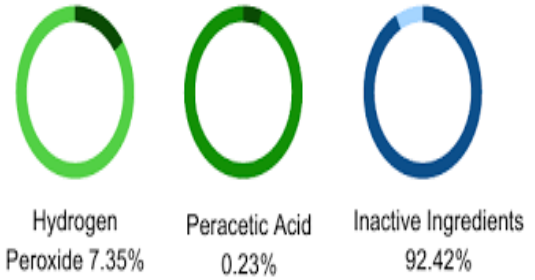
Recent Advances

Vaporized Hydrogen Peroxide (VHP) – The Biggest Breakthrough

- Hydrogen peroxide is now widely used in **vapor/gas form instead of liquid**

- Recognized by regulatory bodies (like FDA in 2024) as a **standard sterilization method**

Hydrogen peroxide and Peracetic acid



- **High-level disinfectant**: PAA is strong oxidizer.
- CDC and EPA approved for highly resistant microorganisms like
- *Clostridioides difficile* and *Candida auris*.
- Commercially available in India as high level disinfectant for OT and ICUs for surface, instruments and environment disinfection. (e.g. BS Peroxy, Zuverlasse).
- PAA is biodegradable, decomposes down to acetic acid, water and oxygen. PAA is resistant to degradation by catalase and also active in the presence of organic matter.

Vapourised Hydrogen Peroxide (VHP)

- **Vapourised Hydrogen Peroxide (VHP) Technology**, enhanced with **Escalated Hydrogen Peroxide (EHP) Technology-stabilized for prolonged efficiency**
- Superior microbial kill with prolonged stability.
- **Uniform penetration into hard-to-reach surfaces:** ideal for **terminal disinfection** of enclosed critical areas such as ICUs, NICUs, ICCUs, OTs, and recovery rooms.
- **Material Compatibility:** Compatible with stainless steel 316, titanium, glass, plastics (PEEK, PTFE, PC), ceramics, and painted surfaces.
- **Sporicidal Action:** Achieved with 50-65 ml per liter in DM/RO water in vapor machine with a contact time of 20-30 minutes.

Proven Broad-Spectrum Efficacy with European EN Certifications

- **EN 17126:2018 (E)** : Sporicidal
- **EN 17272:2020**: Bactericidal ,Mycobactericidal, Yeasticidal,Sporicidal, Virucidal for medical area
- **EN 13727:2012+A2:2015** : Bactericidal for medical area
- **EN 14348:** Mycobactericidal activity
- **EN 14476:** Virucidal efficacy
- **EN 1275: 2005(E)-** Fungicidal/ Yeasticidal for medical area
- **EN 1650:2019**-Yeasticidal

Additional certifications

- ISO 9001:2015- **QMS**
- ISO 13485:2016- **Medical devices — Quality management systems — Requirements for regulatory purposes**
- **ISO 21530:2004** for material compatibility and is safe to use on:

a) Stainless steel (316), titanium, cobalt chrome
b) Medical plastics (PEEK, PTFE, PC)
c) Glass, ceramics, vinyl, laminated and painted surfaces

- **WHO-GMP compliant**
- **CE certified** (Medical Devices Directive 93/43/EEC)
- **Biocidal Products Directive** (98/8/EC).

Bio-Compatibility and Approvals: BS PEROXY™

- 1. **BioCompatibility:** no evidence of skin irritation, skin corrosion,eye irritation, or respiratory irritation observed during assessments of:-
- **OECD 431:2019**: skin corrosion potential is assessed using a reconstructed human epidermis model based on tissue viability.
- **OECD 439:2021** : skin irritation potential using a validated reconstructed human epidermis model.
- **EpiAirway™ Respiratory Toxicity Protocol**: respiratory toxicity is evaluated using a reconstructed human airway tissue model to assess cellular viability and tissue damage.
- **OECD 492:2024**:eye irritation potential is assessed using a reconstructed human corneal epithelium model based on tissue viability.

2. CDC approved as a chemical sterilant

3. WHO recommended during COVID-19: HAI reduction and outbreak prevention.

Advantages of using BS PEROXY™

1. **Ideal : without risk of corrosion or damage.**
- high-value medical equipment
- modular Ots
- critical infrastructure

2. **Rapid action and vaporization capability** :
- complete environmental disinfection: significantly reducing microbial load and cross-contamination risks.

3.**Inbuilt corrosion inhibitors and Low-concentration high efficacy:**
- reduces product consumption, manpower dependency, and downtime
- resulting in lower operational costs while maintaining the highest hygiene standards.

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Advantages of using BS PEROXY™

- Optimized Consumption & Lower Chemical Cost
- Reduced Manpower & Time Savings:
- Lower Equipment Maintenance Cost:
- Reduced HAI-Associated Financial Burden:
- Single Product – Multiple Claims:
- Environment & Staff Safety = Long-Term Savings

WHO Remmomended for Covid -19

Now With (EHP) Technology

CDC Approved

Summary of BS- Peroxy VHP

1. **Advanced VHP & EHP Technology** for Complete Disinfection
2. Proven **Broad-Spectrum Efficacy with European EN Certifications**
3. **Biocompatibility:Non-toxic • Non-carcinogenic • Non-irritant** • Residue-free and non-corrosive
4. **Excellent Material Compatibility**: ISO 21530:2004
5. **Ideal** for high-value medical equipment, modular OTs, and critical infrastructure, **without risk of corrosion or damage.**
6. **Environment-Friendly & Cost-Effective**
7. **Globally compliant chemical sterilant** : one of the most cost-effective high-level disinfection solutions for critical and high-risk hospital environments based on:

- International compliance
- superior infection control
- equipment safety
- operational efficiency

Thank you

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