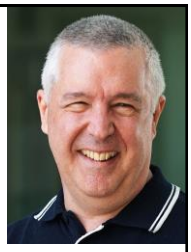
Contemporary Infection Control

2022



Emeritus Professor Laurence J. Walsh AO

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Methods of sterilization or disinfection

- Physical
  - Sunlight
  - Heat
    - Dry heat
      - Red heat
      - Flaming
      - Incineration
      - Hot air oven
      - Infra red
    - Moist heat
      - Below 100°C
      - At 100°C
      - Above 100°C
  - Vibration
  - Radiation
    - Non-ionizing
    - Ionizing
      - Electomagnetic
      - Particulate
  - Filtration
    - Earthenware
    - Asbestos
    - Sintered glass
    - Membrane
- Chemical
  - Liquid
    - Alcohols
    - Aldehydes
    - Phenolics
    - Halogens
    - Heavy metals
    - Surface active agents
    - Dyes
  - Gaseous
    - Formaldehyde
    - Ethylene oxide
    - Plasma
- Physio-chemical

Hydrogen peroxide gas plasma sterilisation

By Professor Laurence J. Walsh AO

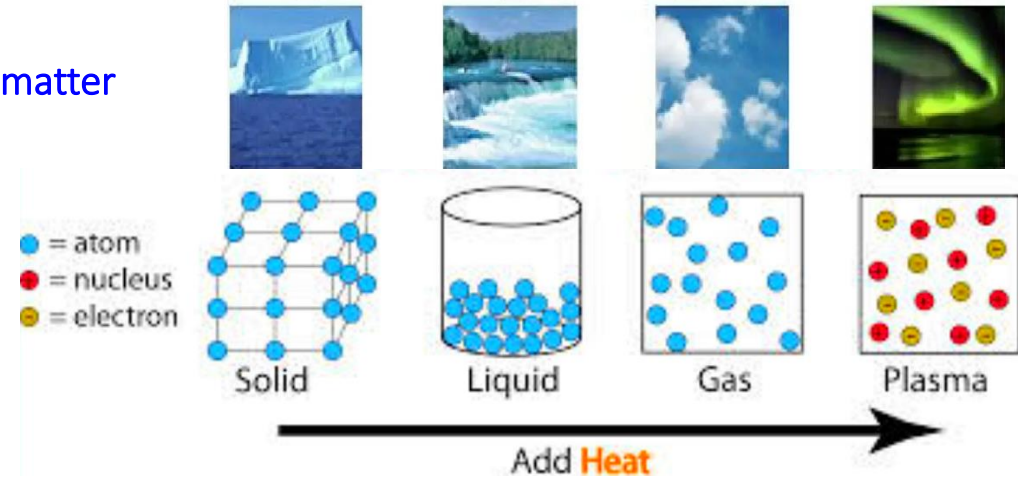
Low-temperature plasmas have been used industrially for a range of processes including surface modification (etching), cleaning and decontamination, as well as for sterilisation of medical devices. The technology has been on the global market since the late 1980s. An example of a TGA-approved hydrogen peroxide gas plasma sterilization (HPGPS) system is shown in Figure 1 and the associated materials for monitoring performance in Figure 2.

HPGPS can achieve greater than a 6 log reduction in viable bacteria or endospores. The hydrogen peroxide is a source for oxygen which in turn generates O, OH, OOH and other radicals, all of which contribute to the sterilising actions. The OH radical is particularly reactive and is especially potent for achieving inactivation of microorganisms.

HPGPS units and their cassette packaging systems require approval by the TGA as medical devices. In Australia, there is not an equipment standard for HPGPS, so the most recent instrument reprocessing standard (AS/NZS 4187:2014) points

4

The 4 states of matter



Plasma is defined as an ionized (or energized) gas with an equal number of positively and negatively charged particles.

Sterilizing methods: HP gas cold plasma

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Dates back to 1987

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Hydrogen Peroxide Gas Plasma

Guideline for Disinfection and Sterilization in Healthcare Facilities (2008)

Overview

New sterilization technology based on plasma was patented in 1987 and marketed in the United States in 1993. Gas plasmas have been referred to as the fourth state of matter (i.e., liquids, solids, gases, and gas plasmas). Gas plasmas are generated in an enclosed chamber under deep vacuum using radio frequency or microwave energy to excite the gas molecules and produce charged particles, many of which are in the form of free radicals. A free radical is an atom with an unpaired electron and is a highly reactive species. The proposed mechanism of action of this device is the production of free radicals within a plasma field that are capable of interacting with essential cell components (e.g., enzymes, nucleic acids) and thereby disrupt the metabolism of microorganisms. The type of seed gas used and the depth of the vacuum are two important variables that can determine the effectiveness of this process.

Used in hospitals for delicate items

Suitable for stainless steel, titanium, aluminium, glass, ceramics.

NOT compatible with cellulose, paper, or cotton (absorbs gas)

- 30-240 litre chamber sizes
- Faster and safer than ethylene oxide; fast turn around
  - Optical devices (laser fibers, endoscopes)
  - Implanted electronics (pacemakers)
  - Ophthalmic lenses
  - Ultrasound probes

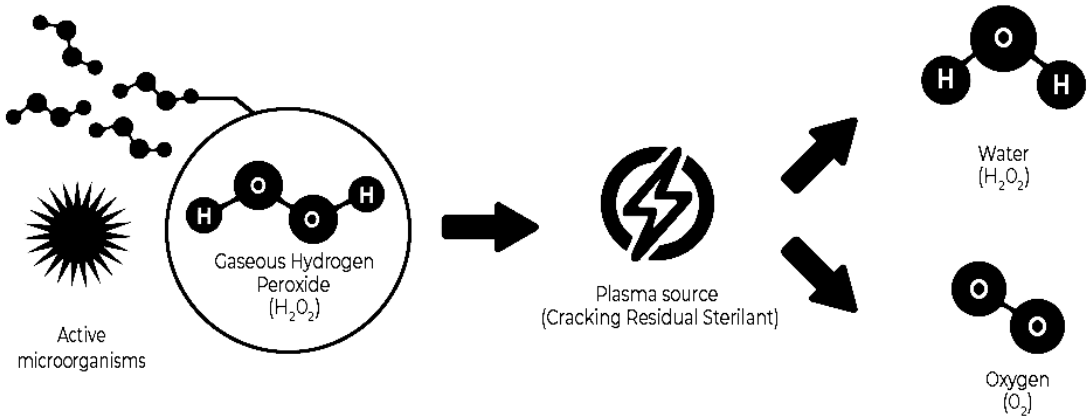
Pure Appl. Chem., Vol. 74, No. 3, pp. 349–358, 2002.

Plasma sterilization. Methods and mechanisms*

Michel Moisan[1,‡], Jean Barbeau[2], Marie-Charlotte Crevier[3], Jacques Pelletier[4], Nicolas Philip[1], and Bachir Saoudi[1]

- In the **plasma** state, the hydrogen peroxide(H2O2) vapour breaks apart into reactive species that include microbicidal free radicals {e.g., hydroxyl (HO) and hydroperoxyl (HOO) } are generated.

Gaseous HP and plasma



7 litre chamber

Chamber and controller Vacuum pump unit

Linear Jet Plasma Source®

On-Demand Gas Plasma Sterilization

The low-temperature alternative to Ethylene Oxide for clinics and small hospitals

Fast and flexible to improve infection control
Extends instrument life
Non-toxic and eco-friendly

Sterilization cycle and minimum time by mode (50 Hz)

Mode	Sterilant cassette	Cycle and minimum cycle time (unit: min)		
		SR™ / SC™	**Sterilization**	**Total Cycle Time**
POUCH	STERPACK	4	**4**	**8**
CHAMBER	STERLOAD	9	**11**	**20**

Plasmapp

Cycle options

POUCH	Total mass of the items should be less than 0.5 kg.
CHAMBER	Total mass of the items should be less that 2.5 kg.

36 or 18 - Minute Chamber Mode

14 - Minute Pouch Mode

7 - Minute Pouch Mode

In Chamber mode the entire volume is usable – just take care not to cover the vacuum port. No space is required in between packaging like with steam autoclaves.

The following items should not be processed by the STERLINK MINI sterilization system.

- Single use items for which the manufacturer does not recommend re-use.
- Liquid and powders.
- Items or materials that absorb liquids.
- Items made of materials that contain cellulose, such as cotton, paper or cardboard, linens, buck towels, gauze sponges, or any item containing wood pulp.
- Paper instrument count sheets or lot stickers.
- Items with mated Nylon® surfaces.
- Instruments and devices that cannot withstand a vacuum and are labeled for gravity

Venting phase

- All the HP decomposes into water and oxygen
  - Vented chamber contents pass through a HEPA filter
  - A chemical treatment system removes ozone and oxygen radicals
- The HEPA filter and the ozone inactivation cartridge are both user replaceable items every 6-8 months
- Packaged items are *slightly warm* at the end (just above body temp)
  - Max chamber temp is < 57°C
- There should be no residues of concentrated liquid HP at the end (these would pose an irritation risk)

Chemical indicators for HP plasma sterilization

Chemical Indicator

VH_2O_2 compatible CI/BI tape or strips are

Chemical Indicator

VH_2O_2 Class 4 CI Strip

User maintenance

- Weekly
  - Wipe chamber with clean damp towel.
  - No need for scale removal as with steam sterilizers
- Every 6-8 months (= 15 mins)
  - Replace HEPA filter; Replace ozone cartridge
- Annually
  - Replace mineral oil in the vacuum pump,
  - MFR recalibration (link to annual validation)
- Note:
  - Cloud based cycle tracking for monitoring any issues.
  - Unit stores 80 cycles of data internally (then over-writes). Includes performance graphs (pressure vs time).


UQ Oral Health Centre