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FOG DISINFECTOR

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ABSTRACT

We have witnessed the emergence of some new infectious diseases, many of which were major public health threats that were met with important infection prevention strategies. Now, an outbreak of novel coronavirus (SARS-CoV-2), which causes the corona-virus disease 2019 (abbreviated COVID-19) has spread rapidly. Environmental contamination of hospital surfaces primarily contributes to infection transmission for many pathogens. Transmission of the COVID-19 virus has been linked to close contact between individuals within closed settings, such as households, health facilities, assisted living, and residential institution environments. Besides, community settings outside of health-care settings have been found vulnerable to COVID-19 transmission events including publicly accessible buildings, faith-based community centres, markets, transportation, and business settings. The level of surface contamination with COVID-19 is not familiar and has not been discovered yet but studies have revealed that disinfection leads to decreased transmission. Significant reduction in infection rates after chemical fogging of the hospital has been observed in several studies. [A]. With the objective of effective disinfection, we bring you the concept of fogging technique. For the same, an efficient fog generator has been designed by us for disinfection of any surface and inanimate objects. Our machine uses thermal fogging differently it generates vapour of disinfectant liquid on passing with high pressure through a narrow heated copper pipe. The particle size of fog (controllable in our instrument) being smaller than that of liquid, have more mobility and penetration to deeper surfaces which gives proper and effective disinfection. This allows us to achieve our target of inhibition of the transmission of virus from inanimate objects to human beings. So, disinfection using fog will be a boon to society during the crucial time of the pandemic.

KEY WORDS:

DISINFECTION 1, FOG DISINFECTOR 2, CHEMICAL FOGGING 3, VAPOUR STERILIZER 4, MOST EFFICIENT DISINFECTION FOR INANIMATE OBJECT 5, DISINFECTION BY THERMAL FOGGING 6, CHEMICAL FOGGING MACHINE 7, ELECTRIC FOGGING MACHINE 8, ROOM DISINFECTOR 9, HOSPITAL WARD DISINFECTOR 10.

INTRODUCTION

Infectious diseases are spread by either bacterial or viral agents and are ever-present in society. Usually infected cases are present in numbers in numbers below an expected threshold but everyone in a while there may be an outbreak. An outbreak may occur in a community or a geographical area, or may affect several countries; it might have a significant impact at either a local or global level. It may last for a few days or weeks, or even for several years. Epidemics are infectious diseases or outbreaks that spread rapidly to a large number of people in a given population over a short Time period. But the term epidemic is not just used with infectious diseases; instead, it is also used with any scenario that leads to a detrimental rise of health risks within a society.

Pandemics on the other hand are terms used to describe an epidemic when the spread is global. More precisely worldwide outbreaks spreading quickly in a large number of people often caused by a new virus or

The strain of the virus that has not circulated among people for a long time.

Preventing a Pandemic[E]:

The chances of an epidemic to grow into a pandemic should be reduced. This requires organisations and nations to act early and be prepared. A set of policies to try to limit the spread of an infectious agent beyond the initial individual cases and small clusters of infection are termed Containment. Several measures have proven effective in the control and containment of viruses:

Controls - application of border controls to limit/prevent movement of individuals to and from affected areas.

Identify cases - educate the public on the symptoms and risk factors; provide easy access to testing, flag potential cases in any healthcare encounters, track contact with infected individuals.

Trace contacts - a labour-intensive process which tracks an infected individual's movements from the moment of infection to identify all individuals who have been potentially infected.

Quarantine - separate an individual suspected of infection from contact with others for a certain time that covers the period of incubation for the disease.

Isolate - separate an infected individual from contact with others.

Protect - use appropriate equipment (PPE) to protect healthcare workers who cannot avoid contact with infected individuals.

DISINFECTION AND STERILIZATION

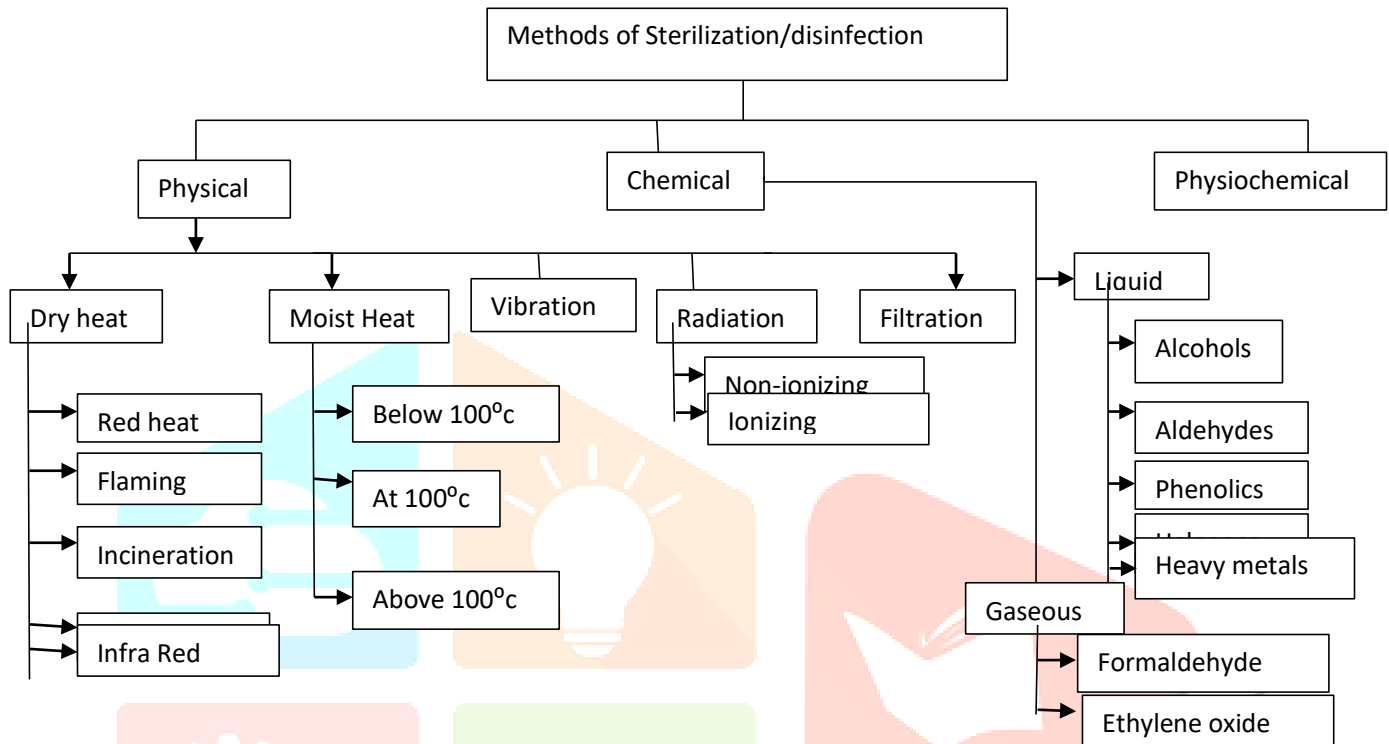
Killing process of all microorganism by physiochemical methods are called Sterilization. Sterilization is meant for inanimate objects. Chemicals used as sterilizing agents are called chemosterilants.

The process of annulment of most pathogenic microorganisms (excluding bacterial spores) by physical or chemical methods is known as disinfection. Disinfection is meant for inanimate objects only. Chemicals used in disinfection are called disinfectants. Not all microorganisms can be killed by disinfectants. Some methods of disinfection extract out all microorganisms present there.

Sterilization and disinfection are not synonymous. Sterilization is the process of killing of microbes whereas, disinfection is the removal of microbes.

Sanitization is the process of decontamination of different surfaces (animate and inanimate), applicable in public healthcare systems. It reduces microbes to safe, acceptable levels for public health.

METHODS OF DISINFECTION AND STERILIZATION



PHYSICAL METHODS OF STERILIZATION:

SUNLIGHT: The presence of ultraviolet rays in sunlight contributes to its microbicidal activity. It is responsible for spontaneous sterilization in natural conditions, but isn't sporicidal.

HEAT: Basically sterilization by heat works by oxidative effects as well as by denaturation or coagulation of proteins depending upon the method used 'dry heat or moist heat' and is also limited to those articles which can withstand heat. It includes various methods like flaming, incineration, using infra-red etc.

RADIATION:

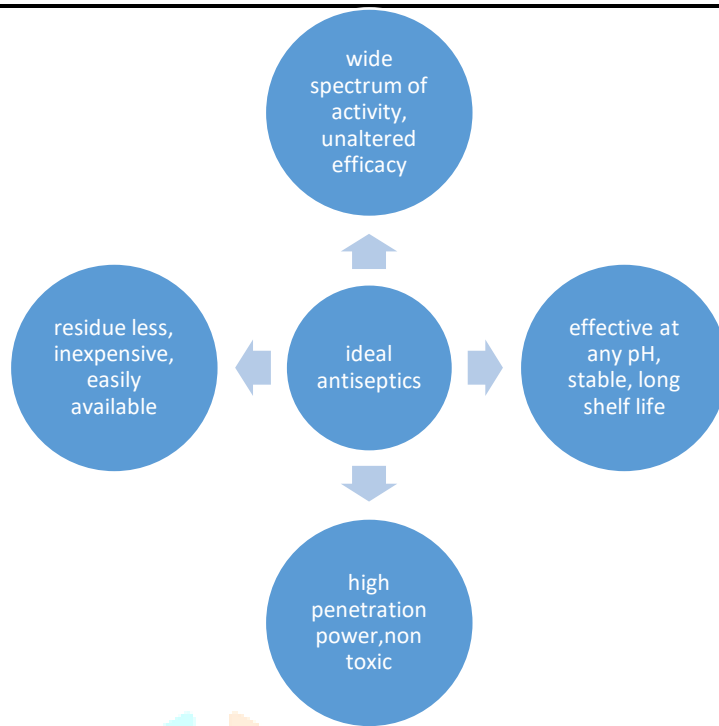
Commonly known as cold sterilization because of types of radiation used ionizing and non-ionizing. Non-ionizing rays like UV are low energy rays (200-280nm) with poor penetrative power while ionizing rays are high-energy rays with good penetrative power. Ionizing rays are of two types: particulate (e.g. - Electron beams) and electromagnetic (e.g. - Gamma rays) rays.

FILTRATION:

Various Membrane filters like earthenware filters, Pasteur-chamberland filters, berkefield filters, asbestos and so on with pore sizes between 0.2-0.45 μm are commonly used to remove particles from solutions that can't be autoclaved. Microbes from thermo-labile liquids such as serum, antibiotic solutions, etc. can be removed by filtration.

CHEMICAL METHODS OF DISINFECTION:

There are two keywords under this category, one is disinfectant and second is antiseptic. Disinfectants destroy pathogenic bacteria from inanimate surfaces and antiseptics are those that can be safely applied on the skin and mucus membranes. Antiseptics have various ideal characteristics summarized below but ideal disinfectant isn't available yet.



Such an ideal disinfectant is not yet available. [G] The level of disinfection achieved depends on contact time, temperature, type and concentration of the active ingredient, the presence of organic matter, the type and quantum of microbial load. The chemical disinfectants at working concentrations rapidly lose their strength on standing. [G]

consistency	<ul style="list-style-type: none"> •gaseous eg. formaldehyde vapour, ethylene oxide •liquid eg. alcohols, phenols
spectrum of activity	<ul style="list-style-type: none"> •high level •intermediate level •low level
mechanism of action	<ul style="list-style-type: none"> •action on membrane eg. alcohol, detergent etc •denaturation of cellular proteins eg. alcohol, phenol •oxidation of essential sulphhydryl group of enzymes eg. H_2O_2, halogens •damage to nucleic acids eg. HCHO, ethylene oxide •alkylation of amino-, carboxyl-, hydroxyl- group

FOGGING:

Fogging is a new and effective method for disinfection. Fog is water vapour in the atmosphere which condenses due to low temperature and forms dense white thing layer in atmosphere reducing the visibility. It is not a pollutant.

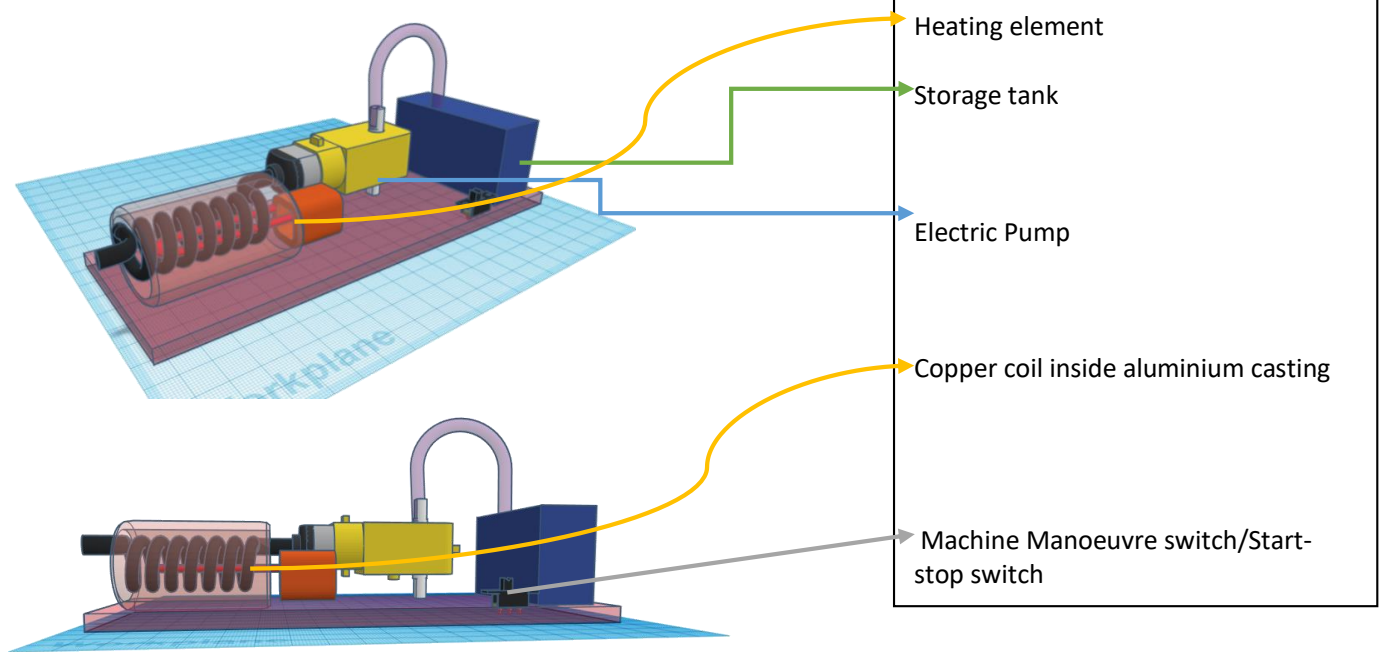
Fogging is more preferable over spraying of liquids because the particle size of fog (controllable in our equipment) being smaller than that of liquid, has more mobility and penetration to deeper surfaces gives proper and effective disinfection. [8]

All the chemical agents that can be converted to fog can be used for disinfection purposes. This can be done by using fog generators or fogging machines. Keeping this in mind, an efficient fog generator has been designed by us.

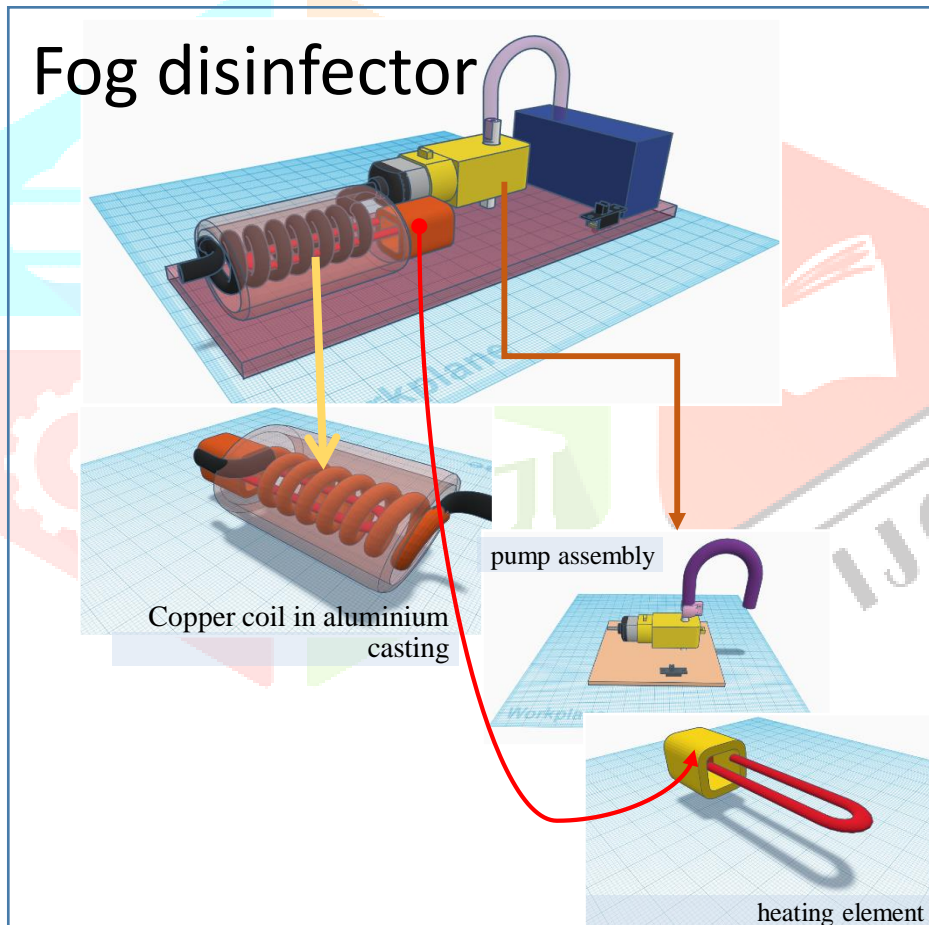
Description of Machine:

The Mechanism of this instrument is very simple. It is based upon simple physics of thermodynamics. When we compress any liquid into a very narrow space, then the boiling point will be reduced, and that liquid can evaporate easily with less amount of heating energy. Also if we increase the surface area in unit length, it will increase the heat circulation. Based on this, **the spiral structure/coil** can provide more surface area for heat. More heating energy can radiate with less amount of electricity consumption. That's why it can produce more vapour/fog of liquid. Also, this spiral structure provides liquid compression.

There are many parts on this machine. It's made up of many small instruments in a single assembly as described below.

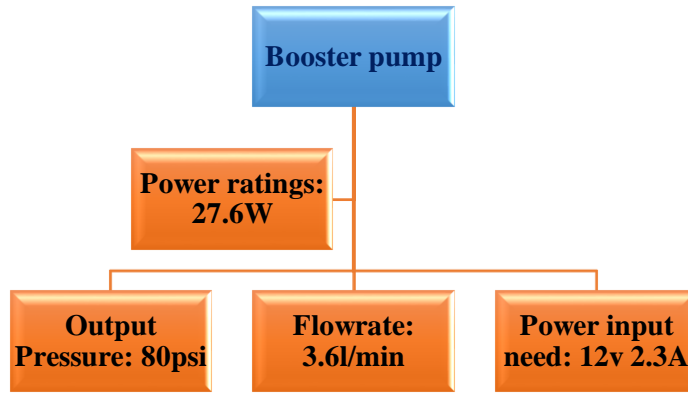


Components of machine:



1. **Aluminium casting:** The quintessential part of the whole machine is the aluminium casting. Aluminium casting. It is very essential. It provides many important things.
 - 1.1. Safety from electricity: short circuits on the heater.
 - 1.2. Safe for heater: in the absence of aluminium casting, a heating rod can get overheated due to technical problem or operational problem it can be destroyed. And overheating can destroy the whole instrument.
 - 1.3. Good conductor of heat: If we fill all the hollow area with aluminium then it provides more heat circulation because aluminium is a good conductor of heat.
 - 1.4. Provides mechanical support: It also provides good mechanical support. It can hold a copper coil and heater on a fixed position during mechanical shock

2. Mini booster pump/jet pump: Instead of a normal electric pump, we prefer this type of pump because it is very smaller in size also can produce huge pumping power. We need continuous high-pressure liquid pumping for liquid compression mechanism inside the copper pipe. The normal pump can't produce the required compression. **This pump gives the main driving force for the fog to spread out all over the area.** Here we use customized mini booster pump



3. Tank for liquid store: 3l to 5l in capacity. Tank should be filled up before the operation. Tank is made up of any kind of plastic, food grade plastic, glass fibre.

4. Thermostat: This is fixed with aluminium casting for safety and to avoid overheating. It will cut off the power supply when temperature rises to 80°C

4.1 Advantage –

- 4.1.1 It saves the whole components
- 4.1.2 Reduce electricity consumption
- 4.1.3 Protect aluminium casting & copper pipe from overheating.

5. Copper coil:

5.1 Advantage-

- 5.1.1 Copper is soft metal, easy to bend and flexible.
- 5.1.2 Copper has highest thermal conductivity 223[B.TU/ (hr.ft.⁰F) [B].
- 5.1.3 Also it cools very fast after operation.
- 5.1.4 Copper is the best heat exchanger for its highest thermal conductivity. It allows heat to pass through it quickly. This Copper used as heat exchangers on Air conditioning, Refrigeration.
- 5.1.5 Recyclable, Cost effective. We can use recycled copper pipe from old refrigeration system.

5.2 Disadvantage –

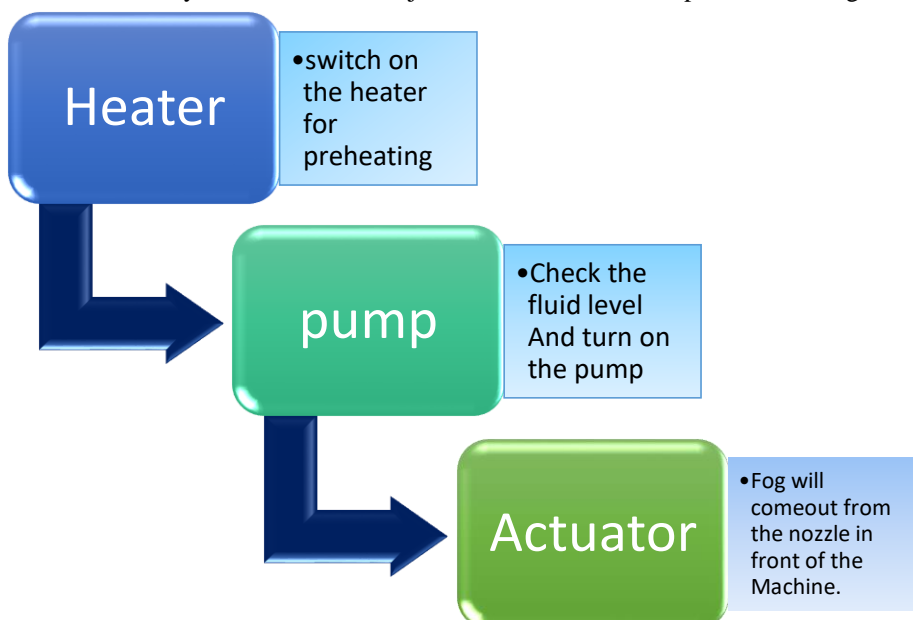
- 5.2.1 Too much soft material
- 5.2.2 Last 3 to 5 years

6. Switches:

3A to 5A switch can be used. There are two switches, one is to activate/deactivate heater and other is for pump activation/deactivation.

Standard operating procedure:

After 2minute preheating operator has to start the pump by engaging its' switch. Then fog will come out from the machine and it will spread on a 3D direction to all over the space. It will produce 3,000 cu.ft of fog within 90 seconds. Total operating time 15 minutes. If heater temperature goes beyond limit thermostat cuts off the power supply. If an operator wants to stay inside the fog then the operator has to gasmask, an operator can wear PPE dress in case of a toxic chemical. But we propose to stay away from the fog. This instrument is made for an only inanimate object, Preferable temperature range 0⁰ to 40⁰c.for smooth function.



Advantages over other fogging and spraying machine:

- **Advantage of Fogging :**
 - Fog's particle size is very small than other liquid particles.
 - Non-sticky to any surface.
 - Fog particle size 5-10 micron (can be controlled by actuator)
 - More mobility of particles. That's why it can spread more .Cover more area with minimum amount of disinfectant.
- ❖ **Advantage of this Machine :**
 - It can produce more Fog.
 - Production volume of fog of this machine is 3000cu.ft which is more than other spraying apparatus.

Disinfecting Chemicals: Here are some chemical disinfectants to be used in this machine. All are liquid in nature. All liquids get evaporated very fast after heating.

Name of Disinfecting agents	Concentration	Side effects and toxicity	Proposed using areas
Isopropyl alcohol + glycerol + water	Isopropyl alcohol (70% w/v), glycerol (30%), Combination ratio 6:3:1.[C,F]	No toxicity, less amount side effects in case of inhalation. Glycerol residue can be left behind; stickiness on surfaces can be occurred.	Inside cars , vehicles, closed chambers, cabins, office, hospital wards(except neonatal ward), outside of vehicles, roads , buildings
Formaldehyde + KMnO4	HCHO (0.002% W/V) Combination ratio 5:1.[3]	Skin irritation, carcinogenic (in case of long term use).	Outside of vehicles [trains, buses].
Zitritide [organic disinfecting agents] derived from extracts of Bitter orange (<i>Citrusaurantium</i>). The active ingredients is polymethoxy-flavonoid (PMF)	The super concentrate is diluted to 1% with active ingredient concentration of 20% volume/volume (v/v). This is marked as stock solution. The stock solution is further diluted to 0.2% (4% v/v) and 0.5% (10% v/v) respectively with demineralised water [2].	No side effects, no extra precautions, proper dress up (PPE) needed.	It can be used everywhere.
60% ethanol 75% isopropyl alcohol	60%ethanol and 75%isopropyl alcohol. Also they can be mixed up with 2-propanol, 1-propanol. In 100 gm 2 –propanol 45gm 1-propanol 30gm.[4]	No toxicity, side effects. It causes eye irritation if directly exposed to naked eye.	In empty cabins, locked room, inside of empty car, especially to sterilise in animate objects.

Costing:

As per present market rate of equipment, we proposed this budget. It can be lower if one manufactures this product in large scale. All are approximate values.

Gross cost Rs- 4000. In case of large scale production it will be under 2000 for each.

Equipment	Cost as per this year 2020	Equipment	Cost as per this year 2020
High Pressure pump	600-800	Metal base plate	<200
Heating element	800	Switches ,connectors,	800
Aluminium casting	1000-1200	PVC pipe, copper pipe	600-800
Jet nozzle with actuator	200-300	Insulator	200

If we use recycled copper pipe .It will lowers the cost. Source of copper pipe – Refrigeration unit of an old refrigerator which is not working. Also Air conditioner’s outside unit is a good source of copper pipe.

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