Disinfecting Scuba Equipment

The future of equipment cleaning in the wake of COVID-19
What exactly is COVID-19?

- COVID-19, or SARS-CoV-2
- Coronavirus
- Enveloped
- Spreads by droplets: coughing, sneezing, etc.
Enveloped virus

- Fatty envelope that surrounds a virus
- Protects the virus when outside the host cell
- Easily damaged

http://academic.pgcce.edu/~kroberts/lecture/Chapter%2013/animalrep.htm#FBBCldHwA41I1bwU80Zbw/wgpyKwual/qg2mKblbw/F95Cf1Q
PlxA/U3QX4fL23d
Why is the viral envelope important?

- Damaging the envelope will damage the virus
- The virus cannot infect anymore and it will die
- Viral envelopes can also dry out and fail to protect the viral contents.
SARS-CoV-2 survival times

- **COVID-19**
  - 2-3 days on plastic and steel
  - Up to 4 hours on copper
  - Up to 3 hours in aerosol
  - Up to 24 hours on cardboard
Similar virus survival times

- Human coronavirus 229E
  - 2-6 days on plastic
  - 5 days on steel glass, PVC, silicone, Teflon™ and ceramic
  - 8 hours on latex
  - 2-8 hours on aluminum

- SARS virus (SARS-CoV-1)
  - Up to 9 days on plastic
  - 5 days on metal
  - 4-5 days on paper
  - 4 days on wood and glass
Will the virus survive on fabric?

- No data on SARS-CoV-2 survival on fabrics
- Very little data on enveloped viruses surviving on fabric
- One other enveloped virus survived for one day on denim
- Experts believe survival time depends on porosity of fabric
- Porous fibers may damage virus particles more easily.
- Viruses may survive for shorter times on natural fibers and longer on synthetics
The importance of disinfection

- COVID-19 survival times inconsistent
- Quicker turn around for rental equipment
- Reduced risk of transmission of COVID-19 between divers
What to disinfect

- Equipment that comes into contact with eyes/face/mouth
  - Mask
  - Snorkel
  - Regulator
  - BCD oral inflator

- Equipment shared between divers
  - Rental equipment

- Equipment that is high-touch
  - Cylinders
  - Fill station

Types and methods of disinfection

- Heat
- Soap and water
- Bleach
- Quaternary ammonium compounds
- Alcohol

Types and methods of disinfection:

Heat

- Can I use hot water to disinfect regulators?
  - Theoretically yes
  - However, soaking time and temperature are high
  - Could cause damage to equipment
  - Disinfectant solution is better

- Can SARS-CoV-2 enter a compressor?
  - Yes, the virus is as small as 0.5 microns, compressor filters catch 5 microns
  - Data shows SARS-CoV-2 can be killed after 15-30 minutes at 133°F (56°C)
  - A compressor heats the gas to around 150°F (65°C) during each stage
  - Peak temperatures reach 400 – 900°F (200-480°C).
Can SARS-CoV-2 enter a cylinder?

- Theoretically yes
- Is cylinder valve or fill whip are contaminated
- Same concept for assembly of regulator
Types and methods of disinfection: Soap and Water

- Soap and water make micelles
  - Water-loving head and water-fearing tail
  - Bond to the fatty viral envelope
- Must be combined with mechanical action
- Soaking equipment in soapy water will not be enough to reliably remove viruses

https://www.defeatdd.org/blog/how-do-soap actuallly-work
Types and methods of disinfection: Bleach

- Destroys proteins in the virus, including the viral genome
- The CDC recommends 1/3 cup in 1 gallon water (4:100) with a soaking time of one minute
- Do not use hot water, this will decompose the active ingredient
- Never mix with other chemicals
- Mix fresh solutions in well-ventilated areas with proper PPE
- Rinse disinfected equipment thoroughly and allow to dry completely
Types and methods of disinfection: Quaternary ammonium compounds

- Hydrophobic compounds that attack the viral envelope and “disorganize” it
- Very common in cleaning solutions
- Harmful to aquatic environment- take care when disposing
Types and methods of disinfection: Alcohol

- Destroys proteins and viral genome
- CDC: 60% alcohol for hands, 70% alcohol for surfaces
- Contact time varies, 30 seconds to 1 minute.
- Alcohol can degrade soft parts of equipment such as o-rings.
- Alcohol is a fire hazard when used near fill stations or heat sources.
Choosing a disinfectant

- Use a disinfectant on the EPA’s “List N”
  - These have been proven to kill SARS-CoV-2
  - Always follow the directions for mixing and soaking time
  - Rinse thoroughly and allow to dry before using

- If unavailable, use CDC’s bleach recipe
Is my chosen disinfectant safe to use on scuba equipment?

- The American Chemistry Council Center for Biocide Chemistries
  - Has a PDF of List N sorted by brand name.
  - The EPA’s List N is sorted by “basic product”
- Search for the EPA registration number for your selected product
- Find the EPA registration
- Find list of uses
  - Should specify dive equipment, respirators, or specific materials
Example: Simple Green d Pro 5  
EPA reg. no. 6836-140-56782

<table>
<thead>
<tr>
<th>Commercially Available Product Name</th>
<th>Company/Distributor</th>
<th>EPA REG No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanifect Plus 1</td>
<td>U S Chemical</td>
<td>47371-131-7546</td>
</tr>
<tr>
<td>Sanifect Plus 2 Fresh N Clean</td>
<td>U S Chemical</td>
<td>47371-131-7546</td>
</tr>
<tr>
<td>SANITIZER / COMMERCIAL SANITIZER</td>
<td>Ecolab Inc</td>
<td>6836-302-1677</td>
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<tr>
<td>Sanix</td>
<td>UNX Industries, Inc.</td>
<td>47371-130-7116</td>
</tr>
<tr>
<td>SD Disinfecting Cleaner</td>
<td>Native Green</td>
<td>6836-77-85898</td>
</tr>
<tr>
<td>Simo-Tab Disinfectant Tablets</td>
<td>Simoniz USA, Inc.</td>
<td>71847-6-18305</td>
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<tr>
<td><strong>Simple Green d Pro 5</strong></td>
<td>Sunshine Makers, Inc.</td>
<td>6836-140-56782</td>
</tr>
<tr>
<td>Stepan Spray Disinfectant Concentrate</td>
<td>Stepan Company</td>
<td>1839-248</td>
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<tr>
<td>SUPER 60 PYM 64 FOAMER</td>
<td>Pioneer Chemical Co.</td>
<td>47371-131-151</td>
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<tr>
<td>SUPER SAN FOOD SERVICE SANITIZER</td>
<td>Ecolab Inc/Kay Chemical Co.</td>
<td>6836-305-1677</td>
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<tr>
<td>Symplicity Sanibet Multi-Range Sanitizer</td>
<td>Betco Corporation</td>
<td>6836-266-4170</td>
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<tr>
<td>Synergex</td>
<td>Ecolab Inc</td>
<td>1677-250</td>
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Screenshot of the American Chemistry Council Center for Biocide Chemistries list of Novel Coronavirus (COVID-19) Fighting Products
Screenshot of the results of searching Simple Green d Pro 5 in the EPA search for registered pesticide products.
To clean and disinfect firefighting…air masks…

…half mask respirators, full face breathing apparatus, gas masks, goggles…
If your chosen disinfectant has directions for different dilutions

<table>
<thead>
<tr>
<th>EPA Registration Number</th>
<th>Active Ingredient(s)</th>
<th>Product Name</th>
<th>Follow the disinfection directions and preparation for the following virus</th>
<th>Contact Time (in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6836-140</td>
<td>Quaternary ammonium</td>
<td>Lonza Formulation S-21F</td>
<td>Norovirus</td>
<td>10</td>
</tr>
</tbody>
</table>
Best Practice

- Disinfect equipment with proven disinfectants
  - Follow directions for use
- Rinse and allow equipment to dry before use
- Don’t re-contaminate equipment after disinfection
- Maintain good hygiene
- Disinfect high-touch surfaces or equipment including cylinders and fill stations
Questions?

- For questions about disinfection, plans to move forward, or other dive safety or risk mitigation questions:
  - RiskMitigation@DAN.org

- For medical questions concerning COVID-19 as it applies to diving:
  - Medic@DAN.org