Use of HVLP Paint Sprayers for Application of the Decon7 (D7) Disinfectant

D7 Overview

D7 is an aqueous-based disinfectant that can rapidly neutralize highly toxic chemical and biological materials. D7 contains surfactants, mild solvents, inorganic salts, a low concentration of hydrogen peroxide (~3.5%), a hydrogen peroxide activator, and water. The surfactants soften the cell walls of pathogens which allows the activated peroxide to penetrate to the interior for complete kill. This unique combination of mild ingredients works synergistically to kill persistent biological pathogens which has been demonstrated in testing at government and private facilities and in many field applications – outperforming formulations that contain much harsher chemicals. D7 is registered by the U.S. Environmental Protection Agency (US EPA) for many pathogens such as *Listeria*, *E. coli*, *Staphylococcus*, *Salmonella*, Norovirus, the Porcine Epidemic Diarrhea Virus, *Staph* and *Pseudomonas* biofilms, and Avian Influenza viruses. D7 is also registered for use against Emerging Viral Pathogens by the US EPA.

D7 can effectively inactivate coronaviruses. D7 has demonstrated effectiveness against viruses similar to Coronavirus or COVID-19 on hard, non-porous surfaces. Therefore, D7 can be used against COVID-19 when used in accordance with the directions for use against Norovirus on hard, non-porous surfaces. Refer to the CDC website at https://www.cdc.gov/coronavirus/2019-ncov/index.html for more information.

D7 is being extensively used world-wide to combat COVID-19 with excellent results. It is currently being deployed in police and fire stations, emergency vehicles, nursing homes, prisons, medical facilities, meat production and other food production facilities, stores and shops, ships and ports, trains, airports, factories, sports venues, schools and universities, as well as many other types of facilities. D7 is approved for use against SARS-CoV-2 by the US EPA.

Deployment of D7 By HVLP Paint Sprayers

D7 can be effectively deployed as a stable foam, as a spray, as a fog or a mist, or by wetted microfiber wipes. Many users find deployment of D7 as a spray to be an ideal method for their application. In this case, an HVLP (High Volume, Low Pressure) paint sprayer is often used since these are readily available at a low cost and are very effective and efficient for D7 application. HVLP systems use a large volume of air at a low pressure to apply liquid (e.g., paint, disinfectant, etc.) to surfaces. Although HVLP sprayers use compressed air typically between 40-100 psi (pounds per square inch), they actually apply the liquid at less than 10 psi as compared to 80 to 90 psi used by conventional spray guns. This lower pressure application causes significantly less "bounce-back," or overspray, as compared to high-pressure systems. This means that an HVLP system can direct the liquid to surfaces much more efficiently than high pressure sprayers. Thus, they are very effective for disinfection operations. In fact, HVLP sprayers were developed specifically to provide a higher transfer efficiency of liquid to surfaces as compared to conventional (i.e., high pressure) sprayers. HVLP sprayers tend to have transfer efficiencies in the range of 60-70% as compared to 20-30% for conventional sprayers as shown in Figure 1 below.[2][3] **This figure clearly shows that use of an HVLP sprayer to deploy D7 to a targeted surface will result in a very high level (i.e., 60-70%) of D7 actually reaching that surface. Therefore, HVLP sprayers are very efficient devices to utilize for D7 disinfection operations.**

There are many variables to consider when evaluating the spray characteristics of an HVLP sprayer such as the inlet air pressure, the nozzle size, the liquid surface tension, and the liquid viscosity. All of these variables will affect the mean droplet size that is produced in an HVLP sprayer. Although there have been studies characterizing the droplet sizes generated from HVLP sprayers with paint and with water, the droplet sizes produced when a disinfectant is used has not been specifically characterized. A typical droplet size distribution (i.e., droplet diameter) for paint and for water is shown in Figure 2 below.[3]

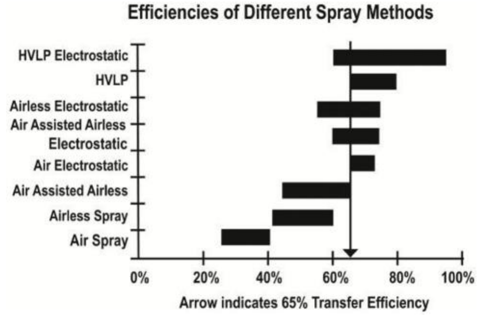

Figure 1: Transfer Efficiencies of Various Spray Methods.[2]

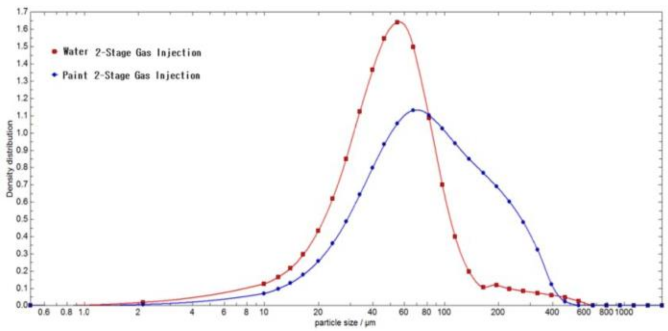

Figure 2: Droplet Size Distribution from an HVLP Sprayer for Paint and for Water.[3]

As shown in the figure, the mean droplet diameter is approximately 50 μm for water and 90 μm for paint. **It is important to note that the liquid surface tension of D7 is significantly less than water (~25 dynes/cm for D7 as compared to ~75 dynes/cm for water) while the viscosity of D7 is only slightly higher than water. In contrast, paint has a lower surface tension than water but a much higher viscosity. Therefore, it is estimated that the mean droplet diameter when D7 is applied through an HVLP sprayer will be less than that of water – probably in the range of 20-30 μm although, as noted above, this has not been specifically measured.**

It has been shown above that if D7 is applied through an HVLP sprayer, approximately 60-70% of the liquid will reach the targeted surface. For disinfection, it is important to know how well the targeted surface will be covered (in other words, will there be a large volume of liquid in relatively few places on the surface or will the liquid spread out over the entire surface). The combination of a relatively small mean droplet size of 20-30 μm for D7 and the very low surface tension of D7 means that the targeted surface will be well covered. With the small droplet sizes, much of the surface will be initially covered due to the very large number of droplets that are generated by the HVLP sprayer (as compared to a much smaller number of larger droplets generated by other types of devices). Because of the very low surface tension of D7, these droplets will quickly flow and spread out over the surface providing a large surface coverage.

When D7 is applied using an HVLP sprayer, it is not always just to target a specific surface. HVLP sprayers are also being used to fill a contaminated space with a fog or a mist of D7 instead of using a conventional fogger. Fogging or misting allows D7 to interact with and destroy the SARS-CoV-2 virus that may be airborne as well as eventually settling to surfaces to destroy viruses that may be on those surfaces (without targeting specific surfaces). For a fogging type of application, important considerations are the evaporation rate and the settling rate of the droplets. This is a very complex subject as the evaporation and settling of liquid droplets in air is dependent on parameters such as the liquid characteristics, relative humidity, temperature, collisions between and combining of the liquid droplets (which is a function of the initial concentration of the liquid droplets in the air), and air turbulence. The settling velocity of water droplets in air has been evaluated in many studies. The results of one such study in stagnant air (i.e., non-turbulent air) is summarized in Table 1 below.[4]

Droplet Diameter (μm)	Settling Velocity (m/s)
10	0.0030
20	0.0118
30	0.0260
40	0.0452
50	0.0689
60	0.0965
70	0.128
80	0.144
90	0.198
100	0.237

Table 1: Settling Velocity of Spherical Water Droplets in Air.[4]

If a mean droplet size of 20-30 μm for D7 is assumed when applied through an HVLP sprayer, it would take a maximum of about 6 minutes for a droplet to settle to the floor in a space with a ceiling that is four meters high. Of course, there are also droplets larger than the mean diameter that would settle more quickly and smaller droplets that would remain airborne for a longer time. In a space with turbulent air, the settling time would likely be longer. However, this data clearly shows (coupled with the evaporation discussion below) that D7 droplets will settle to surfaces to disinfect viruses on those surfaces. However, the settling time is also slow enough for droplets to move around to downward facing surfaces, to the backside of vertical surfaces, and into hidden spaces (e.g., air ducts) to disinfect those surfaces as well.

The evaporation of the deployed droplets is another important consideration. If the D7 droplets deployed from the HVLP sprayer completely evaporate before reaching a surface, they will be ineffective (at least for surface disinfection). **Complete evaporation of the D7 droplets does not occur because of one very simple reason – the air in the space that is being disinfected quickly reaches 100% relative humidity (from evaporation of the D7 droplets that are initially deployed) and evaporation of the remaining droplets stops.[5]** Therefore, after the first few minutes of deployment very large numbers of small diameter D7 droplets are both airborne and are settling on surfaces to disinfect viruses that are in the air and that are on surfaces. This makes deployment of D7 through HVLP sprayers a highly effective disinfection process.

Conclusions

Based on the characteristics of HVLP sprayers and the characteristics of the D7 disinfectant, it can be seen that these types of sprayers are highly ideal for D7 application. This is confirmed by the very successful use of these sprayers in thousands of previous and current D7 disinfection operations in a large variety of facilities – for both small-scale and large-scale applications. Therefore, it is highly recommended that HVLP sprayers be used for D7 disinfection operations.

References

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