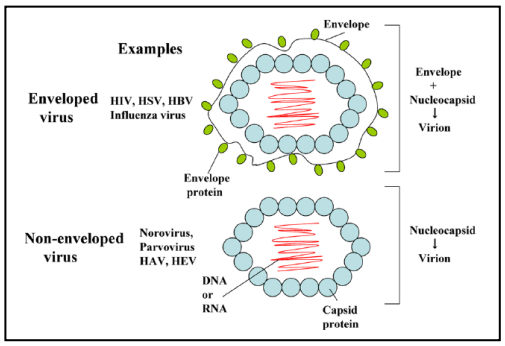
Addressing Coronavirus Concerns With
Gas-phase PCO Technology

Viruses are either enveloped or non-enveloped as shown in the following picture.



Viruses are the most difficult pathogens to test, as they require a living host to incubate and are also very expensive to test. As a result, viruses are the least studied pathogen regarding the effects of photocatalytic oxidation (PCO). The method of testing viruses is normally to use a surrogate, since the actual virus is seldom available. To prove PCO kills a high percentage of Coronavirus (COVID-19, an enveloped virus), a surrogate or close relative of this strain was used for test purposes. Previous testing on H5N8, an enveloped virus used as a surrogate for H1N1 (Swine Flu) and H5N1 (Avian Flu) viruses, has been conducted by Kansas State University, M.T. Ortega, et al 2007, and, using the same reactor employed by Generation 1 UVx units, found a complete reduction in virus viability (100% in 24 hours). Testing has also been done at Kansas State University on Influenza A virus, which H1N1 and H5N1 are a subgroup of. The results showed 100% kill in 10 hours using the same reactor.

Testing by Dr. Leila K. Riley RADIL, LLC in Columbia, Missouri using the same reactor showed a 99.6% reduction in Norovirus (a non-enveloped virus) over a 24-hour period using MNV-4 (Murine Norovirus). Therefore, previous testing does show extremely positive results on very similar enveloped viruses as well as non-enveloped, positive and negative sense viruses (see the following table).

Since COVID-19, positive sense and enveloped, is very similar to H1N1 and H5N1 (both being negative sense and enveloped viruses and being a subgroup of Influenza A virus, negative sense and enveloped). Testing has proven the UVx reactor is also very effective against Norovirus, a non-enveloped positive sense stranded virus. Therefore, it is clear evidence that UVx reactor would have a significant impact on the current strain of Coronavirus.

The illustration included describes the difference between enveloped and non-enveloped viruses. The table on the next page shows some of the testing that has been done on PCO using the UVx reactor and the results.

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Tested Pathogen	Specific Name	Structure	Similar Pathogens	Kill Rate	Reference
Norovirus	Norwalk Virus	Positive sense, non-enveloped, stranded **Virus**	Kennel cough, Canine Hepatitis, Adenovirus, Rhinovirus, Hepatitis A, Conjunctivitis and many, many more	99.9% over 24 hours	Dr. Leila K. Riley, Columbia, MO 11/08
Staphylococcus Aureus	Staph (bacteria)	Gram positive, enveloped, Round-shaped **Bacterium**	Skin infections, abscesses, respiratory infections, sinusitis, food poisoning	99.9% reduction in 24 hours	M.T. Ortega, et al Kansas State, 2007
Methicillin Resistant Staphylococcus Aureus	MRSA	Gram positive, enveloped, round-shaped **Bacterium**	Responsible for several difficult to treat infections resistant to antibiotics	99.9% Reduction in 24 hours, !00% reduction in 24 hours	M.T. Ortega, et al Kansas State; Lyle Labs NYC
Clostridium Difficile	C. diff	Gram positive, enveloped, spore-forming **Bacterium**	Diarrhea, fever, nausea, and abdominal pain, colon issues	99.9% reduction in 24 hours	M.T. Ortega, et al Kansas State 2007
Listeria Monocytogenes	Listeria	Gram positive, enveloped, endospore forming **Bacterium**	Formicates; can affect brain, spinal cord membranes and/or bloodstream of host	100% reduction in 24 hours	M.T. Ortega, et al Kansas State 2007
Group A Streptococcus	Strep throat, GAS	Gram positive chain, encapsulated, **Bacterium**	Scarlet fever, impetigo, rheumatic fever	96% reduction in 24 hours	M.T. Ortega et al Kansas State 2007
Pseudomonas Aeruginosa		Gram negative, rod-shaped, encapsulated ***Bacterium***	Salmonella, Citrobacter ("good" intestine bacteria) S. Marcescens, Pseudomonas, Enterobacter, Cholera, V. Vulnificus, V. Paralaemolyticus; natural resistance to antibiotics	99.9% reduction in 24 hours	M.T. Ortega et al Kansas State 2007
Streptococcus Pneumonia	Pneumonia	Lancet-shaped, gram positive, enveloped ***Bacterium***	Respiratory infections including Pneumonia, Pneumococcal Meningitis	99.9% in 24 hours	M.T Ortega et al Kansas State 2007
Bacillus Anthracis	Anthrax	Gram positive, enveloped, spore forming rod shaped ***Bacterium***	Fever and chills, swelling of neck, nausea, vomiting, diarrhea, flushing and red eyes, swelling of abdomen, could cause death	99.9% reduction in 24 hours	M.T. Ortega et al Kansas State 2007
H1N1	Swine Flu	Negative sense, enveloped, stranded ***Virus***	Fever, cough, sore throat, muscle pains, conjunctivitis, pneumonia and other breathing issues leading to death; myocardial infarction, arterial thrombosis	100% in 10 hours	M.T. Ortega et al Kansas State 2007
H5N1	Avian Flu (Bird Flu)	Negative sense, enveloped, stranded ***Virus***	Fever, cough, sore throat, muscle pains, conjunctivitis, pneumonia and other breathing issues maybe leading to death	100% in 10 hours	M.T. Ortega et al Kansas State 2007
Influenza A Virus	Influenza	Negative sense, enveloped, stranded ***Virus***	Fever, cough, sore throat, muscle pains, conjunctivitis, pneumonia, and other breathing issues possibly leading to death	100% in 10 hours	M.T. Ortega et al Kansas State 2007
Comparative Pathogen					
Coronavirus	COVID-19	Positive sense, enveloped, single stranded ***Virus***	Upper and lower respiratory infections	Surrogates: H1N1 and H5N1	Not characterized

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