Biocidal Wash of Interior of Acrylic Vessel

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Criteria

1. The wash should remove any biological activity on the inner surface of the vessel and prevent it from restarting until such time as the vessel can be filled with asphyxiant gas.

2. The wash should be absolutely safe from the point of view of the acrylic, and safe for human operations on the cavity deck providing reasonable precautions are taken.

3. The wash will be applied once the cavity is sealed. Soaker hoses will be lowered into the vessel and turned on for as long as is necessary to kill the most resilient organisms.

4. After application the biocide must be removed by a wash of clean DI water. It has been demonstrated by Ramey and Smit at UBC that organic biocides in concentrations less than lethal can actually provide nutrients and promote activity.

5. After the rinse, the fill cycle can begin. It is not expected that the water will contain free-floating biological material. The volume above the water will be filled with an asphyxiant gas or filtered air.

6. These principles above may also be applied to washing the outer surface of PSUP and the cavity-liner.

Basic Calculations

1. Tests at UBC have shown Adesol 20, Amberquat and Cidex to be effective in killing the kind of biofilm which grows on acrylic. Concentrations of at least 100ppm seem to be necessary. We will assume 1% as a baseline for the following calculations. The manufacturers of Cidex recommend 10 hours for killing the most resilient biofilm; we will use this conservative number as a baseline.

2. Corrosion. There should be no effects on the acrylic. We have soaked acrylic briefly and have observed no optical effects. We should soak samples for many days and refer to Peter Doe for possible strength-reduction. The materials are billed as friendly to acrylic, but one doesn't know what level this refers to.

3. The biocide has to work when applied by soaker hose. The Adesol 20 is not a surfactant and will need some added. The Cidex and Amberquat are made for washing down surfaces in hospital environments.

We will assume that the draining time is small (a few minutes) compared to the killing time (a few hours). So, we work on the assumption that biocide can be recycled from the sump at the bottom of the vessel and returned for re-spraying.

If we assume we should coat the acrylic to a 1mm thick layer and let it drain off, then 0.5t of diluted material is needed, or 5kg of neat biocide. This should not pose any logistical or safety problems. The LD50 for human consumption of is such that large amounts would have to be ingested to cause harm.

After spraying, all the biocide will be pumped out and disposed of inside the mine or taken outside.

4. Tests need to be done to establish that the material can be removed by a rinse. This might be difficult! We believe that we need to remove all the biocide to the level of 1ppm or the residual material might provide nutrients,

Possible Tests

1. Biological: plate-counts and radio-labelled amino acid uptake.

2. Visual: try the procedure and see what the result looks like. Is the acrylic left in spotless condition?

3. Photometric: check the optical properties of the acrylic before and after. We observe no change after washing.

4. Electron-microscopy: we may be able to see bugs on the acrylic before washing and see if they're still there after washing. How long after will it stay clean in normal but careful use? Microscopy might be sensitive to biocide residues. This might be a very powerful technique, but we haven't tried it yet.