# Radon Emanation from Black Acrylic

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A large 0.25 inch thick piece of black acrylic (Canada Plastics, Toronto) was received. It was cut up into two pieces: 17 cm by 58 cm and 20 by 58 cm. All edges were carefully "carved" clean with a razor blade and all the faces were wiped clean with alcohol on a Kimwipe.

The two pieces were put into emanation chamber #3 (all acrylic with a teflon O-ring seal) and pumped for a total of 51 hours with a liquid-nitrogen trapped oil roughing pump. The ultimate pressure reached in the chamber was 120 microns (0.12 Torr) as compared to 85 microns for the empty emanation chamber.

The black acrylic was allowed to emanate for three days before the radon was extracted. The pressure in the emanation chamber rose to above 1000 microns over the three days.

There was 21.0±4.6 counts observed after one day of counting. The background of the empty emanation chamber radon board and ZnS cell was measured to be 9±3 counts in one day.

Taking a detection efficiency of 66% for the cell, 3 alphas per radon decay, a transfer efficiency of 75% from the emanation chamber to the small trap, a transfer efficiency of 75% from the small trap to the ZnS cell and allowing a correction factor for emanation of 3 days gives:

62.3±11.2 radon emanated per day from the acrylic.

Using a total area of 0.44 $m^2$ (both sides) implies an emanation rate of 6.0±1.1 Rn $m^{-2}hr^{-1}$.

The acrylic was allowed to emanate another 3 days and the radon was extracted. There were 112±10.6 counts in 264295 seconds of counting. This corresponds to 82.3±10.7 radon emanated per day from the black acrylic or 7.9±1.0 Rn $m^{-2}hr^{-1}$.

A third extraction gives 8.0±1.0 Rn $m^{-2}hr^{-1}$.

We are seeing radon from the black acrylic well above the apparatus background and corresponding to an avergage of **7.6±0.9 Rn $m^{-2}hr^{-1}$**. This is in contrast to clear acrylic that has been measured to have <0.6 Rn $m^{-2}hr^{-1}$.

An emanation rate of 7.6±0.9 Rn $m^{-2}hr^{-1}$ from a 36 inch diameter gate valve surface of black acrylic supports 680 Rn in equilibrium in the cover gas if there was no $D_2O$ below it. In the real detector some fraction of the emanated radon actually enters the $D_2O$ in the vessel neck and eventually finds its way into the vessel. This fraction is not expected to be large compared to $D_2O$ at $10^{-14}$ gU/g supporting $6 \times 10^4$ Rn.

The emanation results suggest that black acrylic is suitable for the valve that goes on top of the acrylic neck and forms the universal interface seal.