

Performance Degradation on Large Apertures Due to Ice Buildup

By Dick Knadel K2RIW & Mike Feher

Can anyone recommend a reference that would address the subject for frequencies between 7 and 30 GHz? I realize that it would have to be an approximation as there are too many variables, but, a fairly thorough Google search on my part did not yield any results. I am familiar with performance degradation due to tolerance variations across the surface as a function of wavelength, and, expect ice to be somewhat similar, but, not certain.

Thanks - Mike B. Feher, N4FS

To N4FS & The Microwavers de K2RIW 3/03/10

Mike,

Water has a dielectric constant of about 81 at most RF frequencies. It is a very RF-absorptive substance. That's primarily how your Microwave Oven (uw) works. With a proper layout, water makes a good uw dummy load.

But, when water freezes, it becomes an entirely different substance that has almost no RF absorption characteristics, and a Dielectric Constant of about 3. Place an ice cube, or a snowball in your uw oven, alongside a glass of water, and you'll discover that only the glass of water experiences any RF heating. That gives you some idea why the uw oven has a so-called Frozen Food Defrost cycle mode of operation.

The exact RF properties of water, ice, and many other substances are contained in an old, large format book authored by Von Hippel (I'm not sure of the spelling).

For a rough approximation, I think you assume that your blob of ice has a Dielectric Constant of 3, and a very low Loss Tangent. You could literally make a double convex lens out of ice, and place it in front of your feed horn, if you desired to do RF focusing.

There are many parabolic dish antenna Ground Stations that seem to perform very well with a considerable amount of ice and snow on their surface. I believe the major problem would be an ice build up on the feed horn causing a lensing effect.

73
Dick, K2RIW

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Good

SHF/EHF

DX,

Dick,

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Thank you for a very common sense approach to give me a better handle on this issue. It sounds like snow buildup would be a lot worse, and, I know that from experience from my home brew TVRO receiver at 4 GHz with an 8 foot Andrew dish back in the late 70's. The question has come up as a consequence of whether or not to place de-icers on some 10 meter military satellite dishes, which are in a relatively moderate climate operating from X through Ka bands. Sounds like it would be a waste of taxpayer's money. I hate to build things to cover the 3 sigma type situations. Thanks again & 73 - Mike

Mike - looks like you got a good answer. i looked thru the antenna design articles i have copied over the years, but nothing. i may have made some observations years ago of the effect of snow on a radome. We had 'snow ropes' to solve that problem. the snow came falling down on top of you when using them.

Will W0EOM