

FOAM PROTECTION AND PRESERVATION OF ARCTIC ICE AIRSTRIPS *

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In any potential world wide conflict, it has been predicted that flights over the Arctic will be essential to successful utilization of air transport. Accordingly, preparation of arctic ice airstrips on ice and snow is necessary. These airstrips must be available for emergency use. Protection and preservation of these airstrips during the temperature conditions prevailing during the short summer period (six to ten weeks) must be carried out, otherwise continual and perhaps impossible maintenance conditions will be encountered. For example, even a small puddle of water may act as a lens concentrating the sun rays, leading to progressive melting of the ice into potholes.

Experiments have been carried out by a party under the direction of Mr. Francis A. Crowley at the Ellesmere Ice Shelf during the past summer. Studies were made of the melt, ablation, and protection afforded by various materials on ice airstrips. Such materials as aluminum, silvered brass sheets, various reflective and absorbing powders, metal foils, painted plywood, etc., were tested. Results which have been reported to date were not encouraging.

Consideration of this problem gave rise to the possibility of utilizing the insulating value of foams as a protective medium for the airstrip. This idea was first advanced last year and appears quite promising. Such foam can be shown to have an insulating value many times greater than ice, with an albedo approaching that of a dry snow. For example, the thermal conductivity of ice is about 1.3 BTU/hr ft °F, while that of foam ranges from 0.02 to 0.03 in the same units, dependent primarily on expansion ratio and/or bubble size. The ratio of resistance of the foam to the transfer of heat from the atmosphere to the ice airstrips is from 40 to 65 times greater than the resistance of ice alone. Either frozen or unfrozen foam would form an excellent protective insulating blanket. Landings and take-offs would present no problems. Repair of the insulating protective blanket would be simple and relatively inexpensive.

Other features of foam which enhance its potential for this application are the many and varied characteristics which can be achieved while maintaining very reasonable logistical considerations. From the logistical standpoint, 800,000 gallons of reasonably stable and highly insulating foam can be generated utilizing air and either pure or salt water locally available and transporting only 100 lbs of foaming agent and generating equipment to the site.

Among the types and variations of foam that can be produced are:

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1. Mechanically Generated Frozen Foam

A high expansion ratio, mechanically generated foam system would be comprised of from 95 to 98% air. Assuming that during the production and application of this type of foam freezing conditions prevailed, a generated foam could be rapidly frozen in place. In addition, a foam frozen in place deteriorates by a mechanism of collapse of bubbles in successive layers, while the remaining layers are still an effective insulating barrier. Frozen foam is not porous, so that any small amount of water obtained by initial breakdown of a surface layer can not pass through to form deleterious water layers on the ice surface. In addition, reflective powders can easily be assimilated by foam systems (in effect they improve the foam stability) to alter the albedo effectively to any desired values.

2. Non-Frozen Mechanically Generated Foams

The possibility exists that for unseasonable summer periods and emergency aircraft usage, the airstrip would require either replacement or repair. In this event, a highly stable non-frozen foam with or without reflective additives can be prepared to repair damage or provide replacement. Such foams would slightly increase the logistic requirements and would have a finite life, but would provide a low cost and reasonable protective system.

3. Plastic Foam

Several chemical companies have recently developed quick setting plastics which have the necessary properties for foaming. Foams of such materials would not deteriorate or melt, but would increase logistics requirements such that their feasibility would be materially dependent upon final use and the experimental performance of other foam systems.

4. Chemical Foam

Also available for consideration are chemical foams which are essentially combinations of foaming agents and gas-producing chemicals which set when in aqueous solution. By covering an airstrip with these powder chemicals, any airstrip melting would result in chemical solution, with subsequent foam generation to provide localized protection.

5. Endothermic Chemicals

The potential of many chemicals to absorb heat upon either solution or reaction in solution offers still an additional possibility for arctic airstrip preservation. Several of the higher energy absorbing systems merit investigation to indicate potential feasibility of such systems.

Experimental work, as outlined above, will be started in the near future to check the feasibility of the foam protection for arctic airstrips and to define the necessary developmental steps.