

Title: "METHOD FOR MAKING ARTIFICIAL SNOW"

BACKGROUND OF THE INVENTION

(1) Field of the Invention

THIS INVENTION relates to a method for making
5 artificial snow, and to a snow skiing slope using such
snow.

(2) Prior Art

In certain skiing resorts, man-made slopes are
created using snow-machines which spray water and com-
10 pressed air in a carefully controlled atmosphere (for
both temperature and humidity) to create a blanket of
snow. These machines are expensive to operate and the
atmosphere is difficult to control, requiring expensive
air conditioning equipment. The man-made slopes gener-
15 ally only extend the operating life of the slope by
approximately 30 days.

In more temperate areas, artificial slopes are
created using mats or mat-like layers of e.g. "Dendex",
"Delta" or "Dri Sno" (trade marks) materials. These
20 slopes require the use of special skis and poles and
cannot truly re-create a snow-covered slope.

In International Application No. PCT/AU85/00267
(Bucceri) there is disclosed a method for making artifi-
cial snow by mixing water with a water swellable polymer
25 to approximately 50-70% of the maximum water retention
capacity of the polymer, aerating the mixture and
freezing the mixture to produce snow crystals which can
be laid on a refrigerated floor to form a skiing slope.
This method has proved very effective but in certain
30 applications the cost of the polymer is a disadvantage.

SUMMARY OF THE PRESENT INVENTION

It is an object of the present invention to
provide a method of making artificial snow which is
relatively simple and inexpensive.

35 It is a preferred object to provide a method

where the snow can be laid in layers e.g. of different crystal size or where a layer of "powder snow" can be laid over a harder base snow.

It is a further preferred object to provide a method
5 where the water can be recovered, and the snow refrozen, as required.

It is a still further preferred object to provide a ski-slope incorporating the snow produced by the present invention.

10 Other preferred objects of the present invention will become apparent from the following description.

In a broad aspect the present invention resides in a method for making artificial snow including the steps of:

mixing water with a surfactant (i.e.
15 surface-active-agent or wetting agent);

agitating, aerating and/or bubbling gas through the mixture to form a foam or froth of water bubbles;

applying the foam or froth of bubbles to the area on which the artificial snow is to be created; and

20 freeze the foam or froth of bubbles to form the snow crystals.

Suitable surfactants comprise one or more from the following group: soaps and detergents; sulphated, aliphatic or aromatic alcohols; linear or branched chain
25 alkybenzene sulphonates; alkyarine sulphonates; sodium dodecylbenzene sulphonate; alkyl sulphonates; anionic, cationic and non-ionic surfactants.

Non-ionic surfactants are preferred as these form a resilient foam with small/minute bubbles which on freezing, produce high quality snow crystals down to powder snow size. Preferably the surfactant forming
5 0.03% to 5% of the mixture by weight. For environmental reasons, bio-degradable surfactants are preferred.

A bulk volume of the mixture may be agitated or

aerated to produce a foam of bubbles on top of the mixture and the foam may be transferred or transported to the area where the snow is to be created. The mixture may be aerated by pumping air through the mixture at the ratio water:air 1:1 to 1:5 (v/v), the preferred aeration range being 1:2 to 1:3 (v/v).

Alternatively, the mixture may be mixed and sprayed from equipment of the type used for fire fighting foam (i.e. a foam generator), the foam of bubbles being sprayed over the area where the snow is to be created.

The foam may be laid over a skiing slope and frozen by the cold ambient air or may be laid over an area covered by a flexible cover or structure into which is pumped cold air or refrigerant. The foam may also be laid over artificial snow formed by the method of International Application No. PCT/AU85/00267 to form a layer of powder snow. Preferably the foam is laid over a refrigerated grid, so that the bubbles break down themselves into the snow crystals. (The mixture is frozen from the bottom upwardly and the weight of the foam above the frozen bubbles assists in breaking down the bubbles into the snow crystals.)

Smaller bubbles may be preferred as these are more persistent (i.e. less likely to break before freezing) and more ice crystals are produced. The frozen bubbles may be compressed or crushed by passing a roller over the bubbles.

BRIEF DESCRIPTION OF THE DRAWINGS

To enable the invention to be fully understood, a number of preferred embodiments will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a schematic view of a first embodiment; and

FIG. 2 is a schematic view of a second embodi-

ment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODI-
MENTS

Referring to FIG. 1, water and linear chain
5 alkylbenzene sulphonate are stored in separate W, S
tanks, and are mixed in a mixing head M in a ratio
of e.g. 97% water: 3% sulphonate and sprayed from a
foam nozzle N of a foam generator FG used to spray fire
10 fighting foam, the foam mixture being sprayed in the
form of a foam of bubbles, the foam being laid in layers
10 over the area of the proposed ski slope 11.

The bubbles have a skin with a low gas permea-
bility and so the entrained air in the bubbles cannot
readily escape. The ambient air e.g. below -5°C causes
15 the skins of the bubbles to freeze to form a frozen
foam of bubbles with the air remaining entrained.

A roller is passed over the frozen layer to
break the frozen bubble skins, releasing the air, and
compressing the bubbles to form snow crystals.

20 The resulting artificial snow has skiing
characteristics similar to natural snow and by varying
the size of the bubbles, the nature of the snow in the
different layers can be varied to suit the desired con-
ditions.

25 Referring to FIG. 2, water and the surfactant
e.g. detergent from tanks, W, S are mixed in the mixing
head M in the ratio 99% water: 1% surfactant and the
mixture is aerated by pumping air into the mixing head
M from air compressor AC at the ratio of water:air
30 equals 1:2 (volume/volume).

The resultant foam of bubbles is laid over a
frozen flexible grid system 20 (e.g. of the type sold
under the "Icemat" trade mark by Calmac Manufacturing
Corporation, of Englewood, New Jersey, U.S.A. - the
35 subject of U.S. Patent Nos. 3,751,935 and 3,893,507),

the flexible grid system 20 being cooled by a refrigeration unit R. The bubbles in the foam freeze from the bottom upwards and break down into the snow crystals which form a layer 21 over the grid. To build up the desired thickness of snow, additional layers of foam are laid down and allowed to freeze to form snow crystals.

If the ambient air temperature is not low enough to freeze the foam of bubbles, cold air e.g. in the form of a curtain may be blown over the foam (see FIG. 1). Alternatively, a flexible cover 30 (see FIG. 2) may be laid over the foam and cold air or refrigerant (e.g. from refrigerator unit 12) may be pumped through or under the cover 30 to freeze the foam.

In another embodiment, the mixture may be aerated with air to form the foam and then frozen by passing CO₂ gas through the foam.

At the end of the ski season, when the air temperature is above 0°C, the snow will melt and if a biodegradable surfactant has been used, little, if any, ecological damage will occur to the surroundings. A catchment may be provided at the base of the ski-slope 11 to collect the melt snow.

To enable the skiing surface to be maintained, the surface may be "shaved", the removed snow melted and refrozen and laid or a fresh layer of the snow crystals may be laid over the existing surface. By controlling the percentage of surfactant and the aeration of the mixture, the fresh layer can comprise powder snow crystals.

It will be readily apparent to the skilled addressee that a wide range of suitable surfactants may be used and that many alternative methods for mixing the constituents, generating the foam of bubbles, and laying the foam, are available without departing from the

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- scope of the present invention defined in the appended claims.

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CLAIMS

1. A method for making artificial snow including the steps of:
 - mixing water with a surfactant;
 - agitating, aerating and/or bubbling gas through the mixture to form a foam or froth of water bubbles;
 - applying the foam or froth of bubbles to the area on which the artificial snow is to be created; and
 - freeze the foam or froth of bubbles to form the snow crystals.
2. A method as claimed in Claim 1 wherein:
 - the surfactant comprises one or more from the group: soaps and detergents; sulphated, aliphatic or aromatic alcohols; linear or branched chain alkylbenzene sulphonates; alkylamine sulphonates; sodium dodecylbenzene sulphonate; alkyl sulphonates; anionic, cationic and non-ionic surfactants.
3. A method as claimed in Claim 1 or 2 wherein:
 - the surfactant forms 0.03% to 5% of the mixture by weight.
4. A method as claimed in any one of Claims 1 to 3 wherein:
 - the mixture is aerated by air in the ratio water:air in the range 1:1 to 1:5 (volume/volume).
5. A method as claimed in Claim 4 wherein:
 - the ratio water:air is in the range 1:2 to 1:3 (volume/volume).
6. A method as claimed in Claim 1 wherein:
 - the foam of bubbles is laid over a refrigerated grid system on a skiing slope, the bubbles in the foam freezing and breaking down into the snow crystals.
7. A method as claimed in Claim 1 wherein:
 - the foam of bubbles is laid over a skiing slope and the foam of bubbles is frozen by the cold ambient air.



8. A method as claimed in any one of Claims 1 to 5 wherein:

the foam of bubbles is laid over a skiing slope and is covered by a flexible cover, and cold air or refrigerant is pumped through or under the cover to freeze the foam of bubbles.

9. A method as claimed in any one of Claims 1 to 5 wherein:

the foam of bubbles is frozen by pumping CO₂ gas through the aerated mixture.

10. A method as claimed in any one of Claims 1 to 5 wherein:

the mixture is aerated in a fire fighting foam generator and the foam of bubbles is sprayed over the skiing slope from a nozzle attached to the foam generator.

11. A method as claimed in any one of Claims 1 to 10 wherein:

the frozen bubbles are compressed or crushed to form the snow crystals.

12. A skiing slope including:

a refrigerated floor or grid; and
one or more layers of snow crystals covering the floor or grid, the snow crystals being made by the method of any one of Claims 1 to 11.
