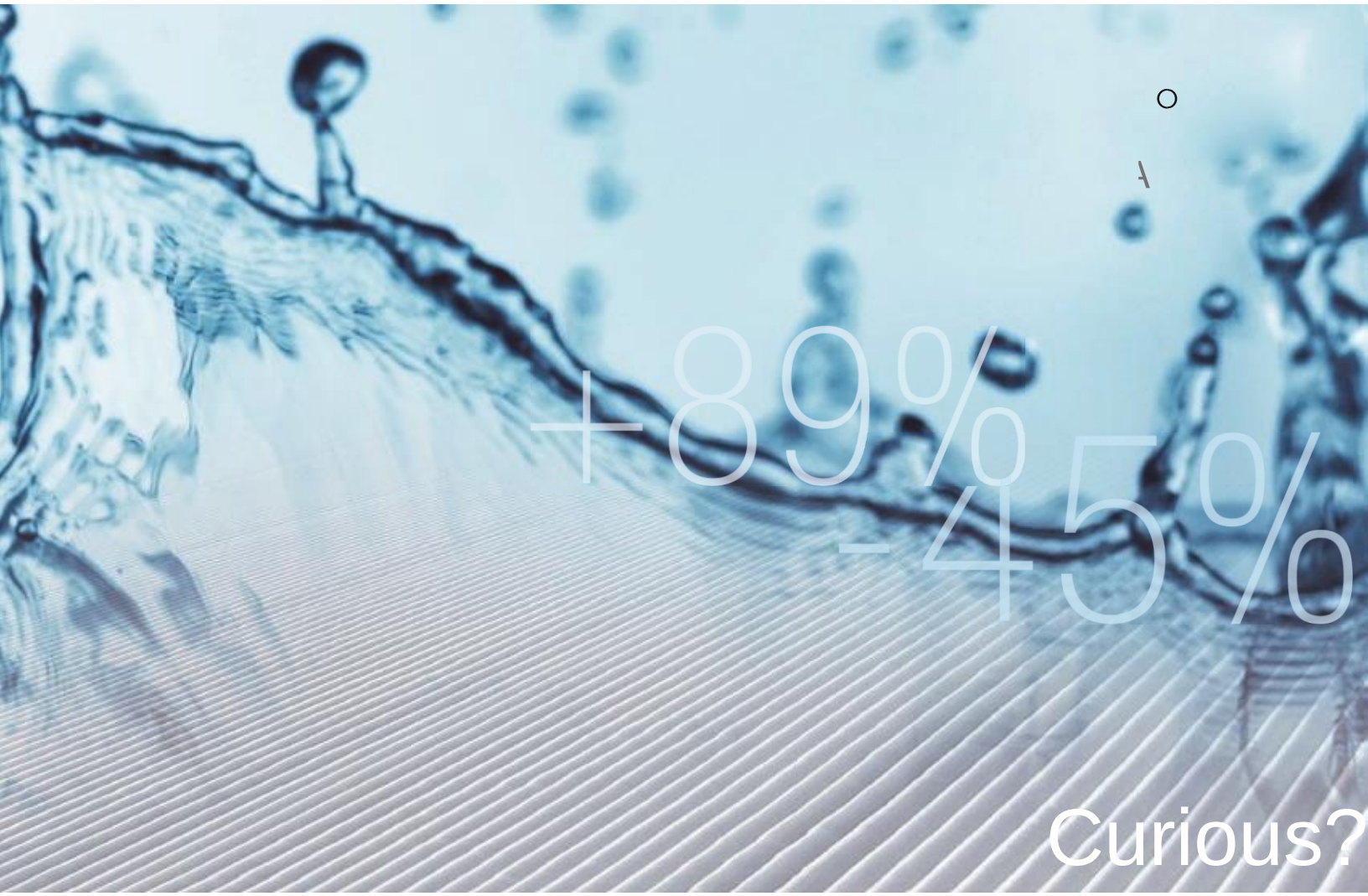
Independent Snomax® Case Study

SNOMAX'S IMPACT ON KIRKWOOD MOUNTAIN RESORT SNOWMAKING OPERATIONS

Conducted by Vermont Energy Investment Corporation
and analyzed by the Brendle Group engineering company



What is Snomax®?

Snomax® is a water additive that raises the temperatures at which water begins to freeze

Causes water to convert from liquid to solid faster and closer to the nozzle of snow guns

Allows ski areas to achieve increased accuracy directing snow onto ski slopes

Provides a faster cure cycle resulting in energy, water and capital cost savings and higher quality snow

Scope of Study

A controlled short-term snowmaking test was conducted at Kirkwood Mountain Resort to collect empirical data on the impact of the Snomax® product on snowmaking operations compared to a baseline process.

Vermont Energy Investment Corporation

Kirkwood Mountain Resort Study

- Vermont Energy Investment Corporation (VEIC), conducted the analysis of snowmaking operations at Kirkwood Mountain Resort
- Measured the impact of Snomax on Kirkwood's snow making operations
- Measured water pressure (psi), water flow (gpm), water temperature (°F), wet bulb temperature (°F), ambient air temperatures (°F), and snow deposition depth (inches)
- Snow grains were compared
- Density was recorded and compared

Dashboard of Findings Day Test

5 Hour Duration

Test Results - Tower Air Water Snowguns	Baseline	SNOMAX®
Average temperature & relative humidity	**17.4 °F / 77% relative humidity**	
Test area & position of snowgun	Skier's left	Skier's right
Total ft^3 of snow deposited	2,622 ft^3	4,943 ft^3
Total acre-feet of snow deposited	0.060 acre-feet	0.113 acre-feet
Gallons per acre-foot of snow deposited	267,531 gal/acre-foot	146,881 gal/acre-foot
Snow density	0.43 grams/cm^3	0.36 grams/cm^3
Air/water ratio	1.26	1.11

Dashboard of Findings Night Test

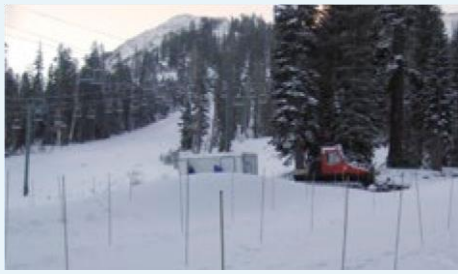
6 Hour Duration

Test Results - Tower Air Water Snowguns	Baseline	SNOMAX®
Average temperature & relative humidity	**3.4 °F / 72% relative humidity**	
Test area & position of snowgun	Skier's left	Skier's right
Total ft^3 of snow deposited	5,381 ft^3	6,998 ft^3
Total acre-feet of snow deposited	0.124 acre-feet	0.161 acre-feet
Gallons per acre-foot of snow deposited	170,093 gal/acre-foot	134,871 gal/acre-foot
Snow density	0.43 grams/cm^3	0.36 grams/cm^3
Air/water ratio	1.39	1.24

Side-by-side Comparison

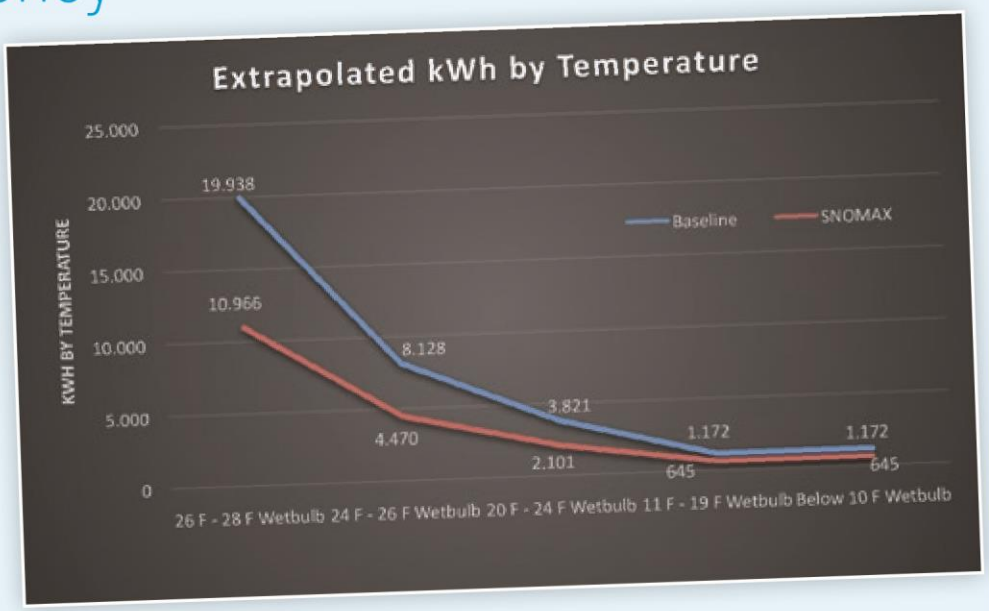
Significant benefits were proven in the side-by-side test

- The overall volume of snow produced using Snomax® increased almost 90%
- Increased from 2,622 ft^3 in the baseline test to 4,943 ft^3 in the Snomax® test
- Water consumption decreased with Snomax® by 45%



Energy Efficiency

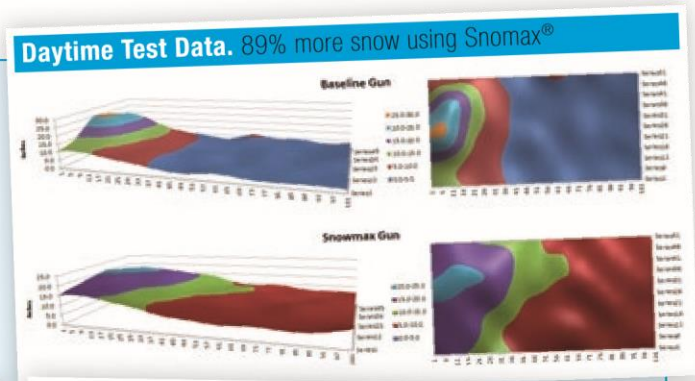
- Adding Snomax® to the snowmaking process yielded significantly increased volumes of snow, using the same amount of energy as the baseline process.
- Calculated cost savings of approximately 50% by using Snomax®

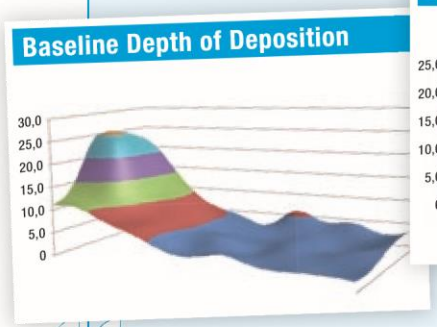


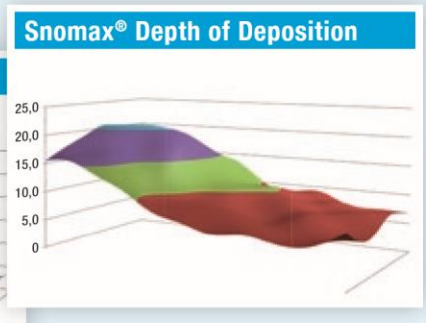
Overall, increased snow production was reported using the same amount of energy compared to snowmaking operations without the Snomax® additive. Survey Comment

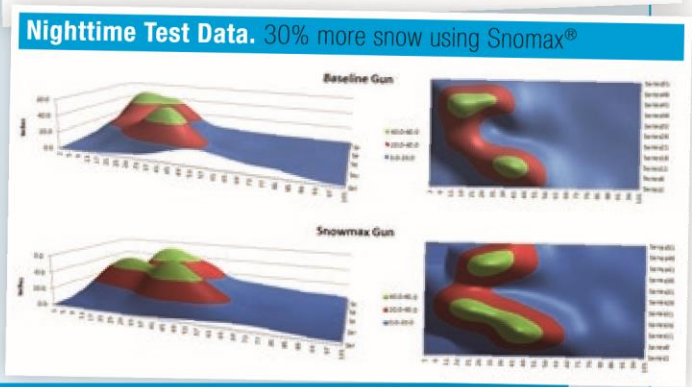
Snow Volume Increase

Over the course of the daytime test, the Snomax® process deposited approximately **350 additional total inches** of snow as compared to the baseline process.





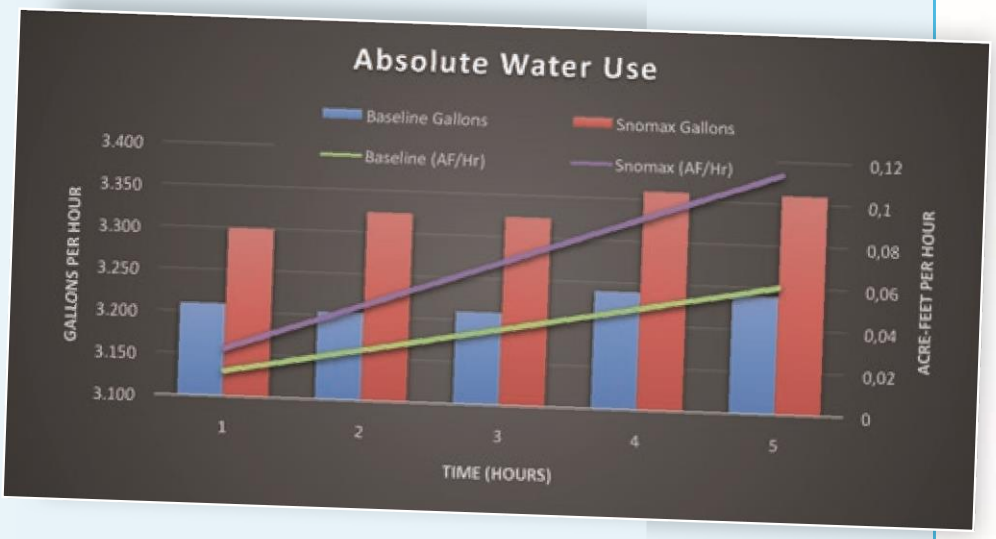




Snow surfaces managers reported improved quality and quantity of Snomax^ snow versus untreated guns. Managers reported Snomax® produced snow piles at a greater volume with decreased water use. Survey Comment

Water Usage

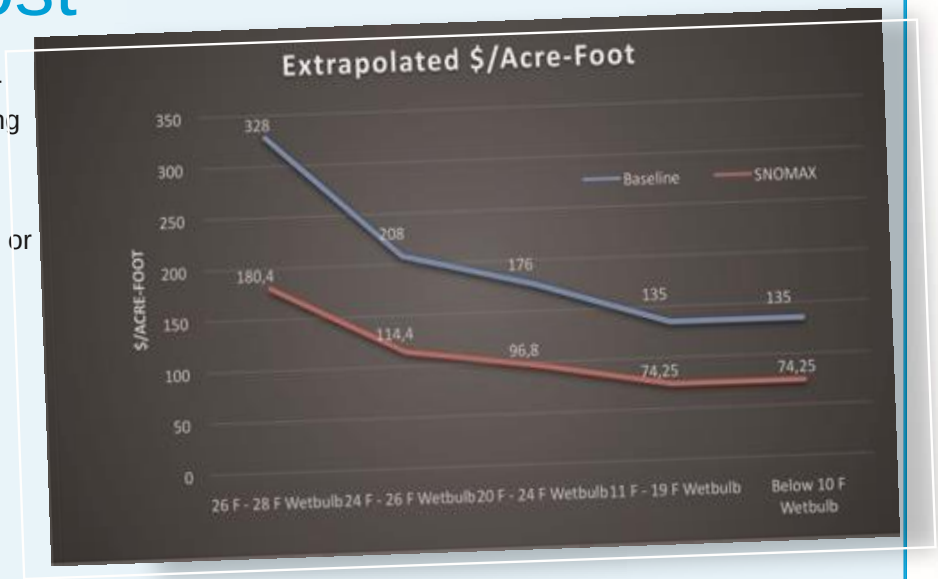
- The absolute water use of the Snomax® process was higher than the baseline process by approximately 3.5% but this increase in water use resulted in an associated increase in snow volume of almost 90%
- Snomax® additive makes the snow-making process more effective overall providing a significant improvement in efficiency with regard to per-unit water use



Operators found that more snow was produced per gallon of water pumped" with Snomax® than without Survey Comment

Operating Cost

- Extrapolation was completed to determine the expected impact on operating costs by using Snomax®
- The $/acre-foot metric used in the comparison excludes any operational or maintenance (O&M) costs
- These O&M costs can represent an additional 10–15% of the overall cost



No direct observations were made regarding operating costs. There are however extrapolations on cost savings, based on water and energy savings, as well as extended snow gun lifespan as a result of increased snowmaking productivity. Survey Comment

Results

Did Snomax® provide any added flexibility to the process?
“Better performance with marginal wet-bulb temperatures.”

What was the apparent learning curve for introducing the product?
“Same time commitment.”

Was there a noticeable difference on grooming requirements or efficiency when using Snomax®
“Yes, drier snow, faster cure cycle, easier dozing.”

It’s all about the water

50% estimated cost savings

45% reduction in rate of water use

89% increase in volume

Environmental Benefits

These environmental benefits of decreased energy and water consumption help preserve the natural resources which in turn support the longevity and viability of winter snow-sports.

Cost Savings Benefits

Cost, energy savings and capabilities offer:

- **Greater opportunity to enhance the skier and rider experience**
- **Extending the season of operation**
- **Reduced costs while potentially increasing revenue**
- **Increase snowmaking crews productivity**

Conclusion

- **Snomax® benefits continue by having made more snow that is longer lasting and easier to groom- preventing subsequent losses associated with grooming time, fuel costs and equipment maintenance**
- **The results of this test proved significant improvements over the baseline process during the same period.**

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