Snowmaking System Engineering

BASIC FORMULAS

1. Typical Material Cost Breakdown of a Snowmaking System

AIR COMPRESSORS	30%
PIPES & FITTINGS	40%
HYDRANTS, REGULATORS & VALVES	5%
SNOWMACHINES & HOSES	5%
WATER PUMPS	15%
SYSTEM ENGINEERING	5%

2. Snowmaking Technology Energy Use Comparison

TECHNOLOGY USED	GPM OF WATER CONVERTED TO SNOW PER KW OF ENERGY	LPM OF WATER CONVERTED TO SNOW PER KW OF ENERGY
1. Air/Water Gun on Tower	**1.0**	3.8
2. Medium Fan Gun on Tower	1.9	7.2
3. Sky Giant Low Energy Gun on Tower	3.3	12.5

*Comparison at 19F (-7.2C) wet bulb temperature.

3. Typical Air Compressor Discharge Temperature

TYPE OF COMPRESSOR	DISCHARGE ABOVE INTAKE
Rotary - Screw	180F
Centrifugal	200F
Reciprocating Piston	350F

4. Calculating Friction Loss of Water in Pipe-lines

$$f = 0.2083 \left(\frac{100}{c}\right)^{1.85} \frac{q^{1.85}}{d^{4.8655}}$$

WHERE

f = Friction head in feet of water per 100 feet of pipe

d = Inside diameter of pipe in inches

q = Flow in GPM

c = Surface roughness constant (100 is used for welded steel pipe)

5. Calculating Air Pressure Loss Due to Friction

$$\text{LOSS IN PSI} = \frac{f \times (CFM)^2}{30{,}302{,}351 \times D \times Pm \times A^2}$$

WHERE

f = Friction factor. Determined by diameter of pipe and relative surface roughness

D = Internal diameter of pipe, feet

Pm = Average pressure in pipe, PSIA

A = Internal cross-sectional diameter of pipe, square feet

6. Calculating Horsepower For Water Pump

$$HP = \frac{\text{GPM x total head in feet}}{\text{3960 x efficiency of pump}} \times SP - GR$$

WHERE

SP-GR = Specific Gravity

7. Calculating Operating Cost

$$\text{COST/HR.} = \frac{.000189 \times \text{GPM} \times \text{total head} \times \text{power rate}}{\text{Overall pump \& motor efficiency}}$$

8. Water Snow Relationships

3.2 Gallons = 1 FT^3 of Snow
1 Gallon = 8.342 lbs
1 FT^3 Water = 7.48 Gallons
1 Acre = 43,560 FT^2
1 Acre Foot of Snow = 180,000 Gallons of Water

9. English to Metric Conversion Factors

English Units	Multiply By	Metric Units
Gallons (GAL.)	3.785	Litres (L)
Gallons Per Minute (GPM)	3.785	Litres Per Minute (LPM)
Gallons Per Minute (GPM)	0.0631	Litres Per Second (LPS)
Acres	0.40469	Hectares
Acres	4046.9	$Meters^2$
Feet	0.3048	Meters
Cubic Feet (FT^3)	0.0283	Cubic Meters (M 3)
Horsepower (HP)	0.7457	Kilowatts
Pounds Per Square Inch (PSI)	6.895	Kilopascals (KPA)
Gal/Min	0.2271	M^3/HR
Hectare-M	10,000	M^3

10. How to Determine Snow Quality

One could collect fresh snow samples and determine weight per Cubic Foot or Cubic Meter and state the quality in density like pounds per Cubic Foot or density per Cubic Meter.

A far simpler and practical method is to test the snow on the ground in the production plume while snow guns are operating by doing a Snow Ball Test. The quality can be determined on a scale from 1 to 6 according to the table below:

The Snowball Test

Snow Quality	Description
1	Snow cannot be packed, powder
2	Snow can only be packed into a loose ball that falls apart
3	Snow can be packed into a ball that can be broken apart
4	Snow can be packed into a dense ball that does not change color when squeezed
5	Snow can be packed into a dense ball that changes to a darker color when squeezed but little or no water comes out
6	Snow can be packed into a dense ball that discharges water when squeezed