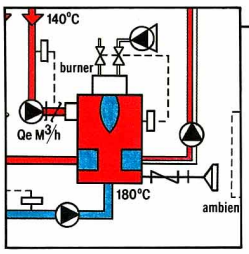


NATURAL GAS SUBMERGED COMBUSTION FOR MELTING SNOW

SITUATION

Montréal receives an average annual snowfall of 250 cm, or about nine million cubic metres.

The City of Montréal is responsible for clearing the snow, and disposes of it as follows

- 31% is dumped into the St Lawrence River;
- 23% is discharged into the sewer system;
- 24% is trucked to the Francon quarry;
- 21 % 5 spread over surfaces;
- 1% is melted.

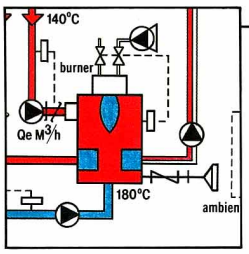
As of April 1996, dumping snow in the river will be prohibited. This decision has forced municipal authorities to reconsider current snow melting operations in terms of efficiency and environmental impact.

PROBLEMS

City of Montréal snow melters use submerged combustion burners fed by no. 1 oil. These burners are several years old and have none of the advantages of modem, more efficient burners. Burner operators also complain about the smell. Maintenance costs are relatively high and the City is seeking to meet increasingly stringent environmental standards.

SOLUTION

Replacing the old oil burners with new, efficient submerged combustion natural gas burners is a solution with numerous advantages.



ADVANTAGES

Submerged combustion systems are better suited to natural gas than to oil because cold walls make it more difficult for oil to burn completely.

Comparative testing done at one City of Montréal snow melting facility showed energy savings of more than 30 % with natural gas burners, as opposed to oil burners.

Natural gas is sulphur free, burns cleanly and, unlike oil, requires no storage. Natural gas also involves lower maintenance costs and improves the quality of the workplace.

TECHNICAL DETAILS

Snow is dumped directly from the trucks into a tank containing water that is heated by a submerged combustion unit. The burner is placed such that combustion products are directed downward through a stainless steel tube immersed in the bath. The combustion products exhaust directly into the water, releasing almost all their heat to the bath before rising along a space between the inside and outside tubes, as illustrated in Figure 1. The resulting turbulence causes the hot water to rise along the tube. It then escapes through an opening at the top and pours out onto the snow piled above the bath and promotes melting. The process is therefore potentially very efficient.

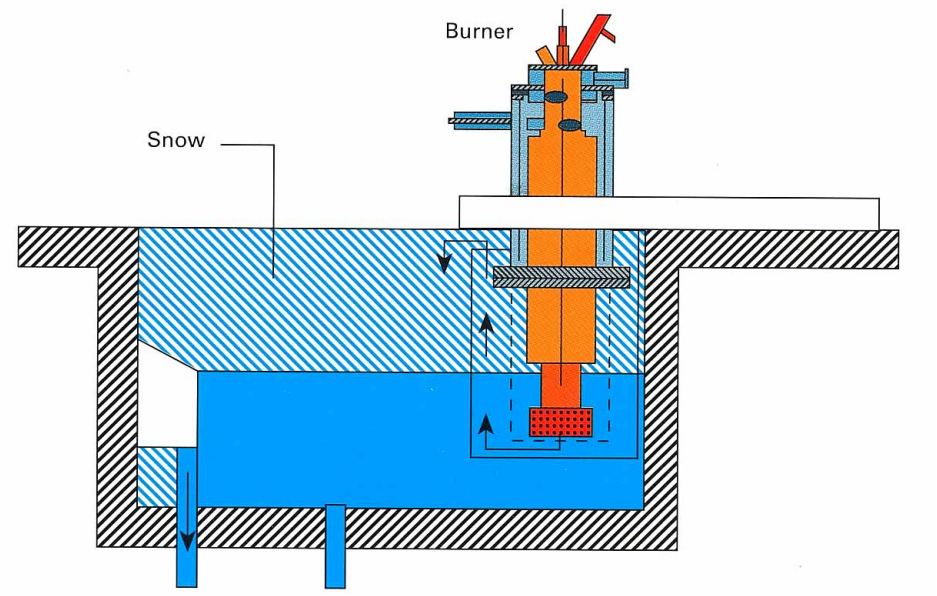


Figure 1 : Snow Melter.

In a typical system, trucks dump snow directly into a tank about 120 feet long. Water in the tank is heated by 10 burners, each with a nominal capacity of 10,000,000 BTU/hr (10,546 MJ/hr).

Figure 2 shows the burner with its combustion chamber and distribution tube. Designed by Gaz de France, the burner is equipped with separate gas and air intakes that are in counter rotation. This assures a stable flame activity in the burner, which can operate at considerable hydrostatic pressures and with an important turn-down ratio. Burner construction provides for intake air to be preheated by contact with the hot walls of the burner.

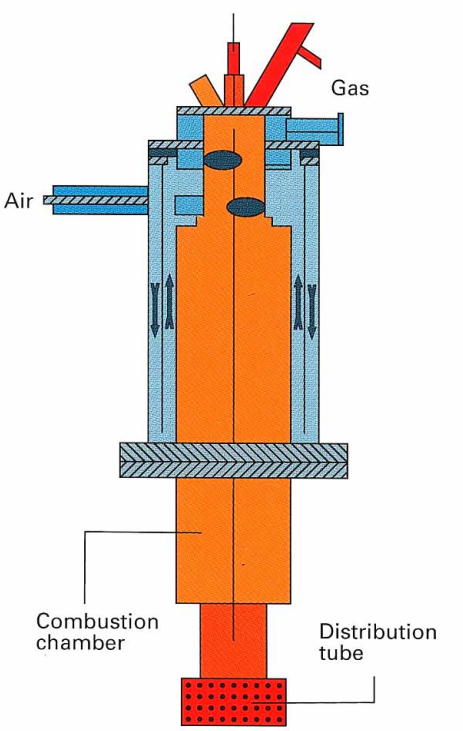


Figure 2 : Illustration of a natural gas submerged combustion system.

The heat output of a submerged combustion unit depends on the temperature of the bath, provided the level of the water that the bubbles pass through is high enough to ensure thermodynamic equilibrium. Submerged combustion is very efficient for relatively low-temperature baths. For exam pie, at temperatures below 59°C (the dew point for combustion products), the water vapour in the combustion products will condense and release their latent heat, which is then used in the process.

At temperatures above 59°C, the water in the bath evaporates and saturates the combustion products, reducing heat output. Heat output decreases as the temperature of the bath rises, as illustrated in Figure 3. However, evaporation efficiency increases, in which case submerged combustion can be used to concentrate the solution.

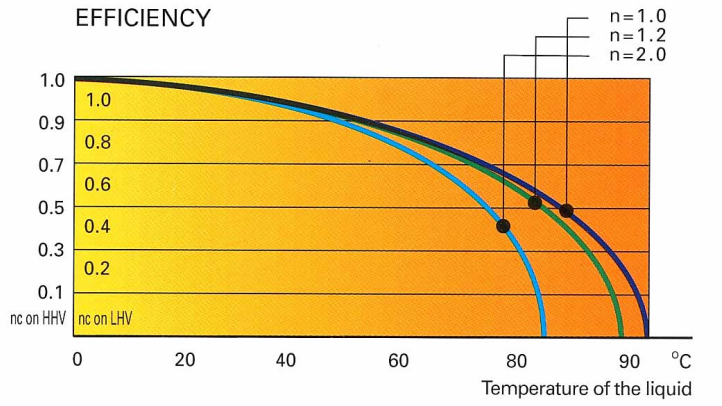
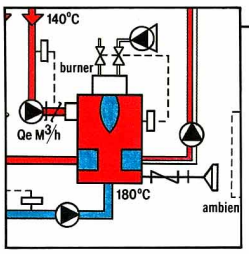


Figure 3 : Submerged combustion — Heat output according to liquid temperature, for different n values of excess air.



OTHER APPLICATIONS

Submerged combustion has many different applications:

Machine Industry

- phosphate baths

Agriculture and Food Industry

- slaughterhouse washing water
- bottle washing
- pasteurization
- greenhouse heating water

Textile Industry

- bleaching
- continuous production of hot water
- tanning

Chemical Industry

- concentrating solutions
- washing water

Other Industries

- mixing cement and plaster
- heating swimming pools
- concentrating industrial wastes
- treating waste water

SUMMARY OF ADVANTAGES

Submerged combustion is an original and very interesting solution from an energy point of view. It can also improve the snow melting process because of the turbulence that occurs in the bath.

The benefits of natural gas submerged combustion, notably a better, odour-free workplace, make it ideal for urban snow melting.

For more information, contact

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