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## CLASSIFICATION OF SNOW REMOVAL TECHNOLOGIES OF AUTOMOBILE TRANSPORT NETWORKS

China's highway snow removal is mainly based on simple and economical traditional snow removal methods, including manual snow removal, mechanical snow removal and chemical snow removal. Manual snow removal method is to remove snow by people, and its advantage is that the snow removal of the road is more thorough, but its efficiency is low, the cost is high, easy to affect the road traffic, and the safety of snow removal workers can not be fully guaranteed [1-3]. The mechanical snow removal is to carry out the snow removal work through specific snow removal machines. Different machines should be equipped for different stages of the snow removal work. The commonly used snow removal machines include: blower snow blower, pear snow pusher, ice breaking snow remover, spiral snow thrower and disc brush snow sweeper [4-6]. The mechanical snow removal is more efficient than the manual snow removal, but it will affect the traffic and damage the road surface, and the cost of mechanical equipment is high, the utilization rate is low, and special personnel are required to maintain [7]. Chemical snow removal mainly relies on the spreading of deicing salt on the road to melt the ice and snow to achieve the purpose of de-icing snow, deicing salt according to its chemical composition is generally divided into chlorinated deicing salt, nonchlorinated deicing salt and mixed deicing salt, spread deicing salt can quickly and effectively de-icing snow, but it has a great impact on the road performance and the surrounding environment.

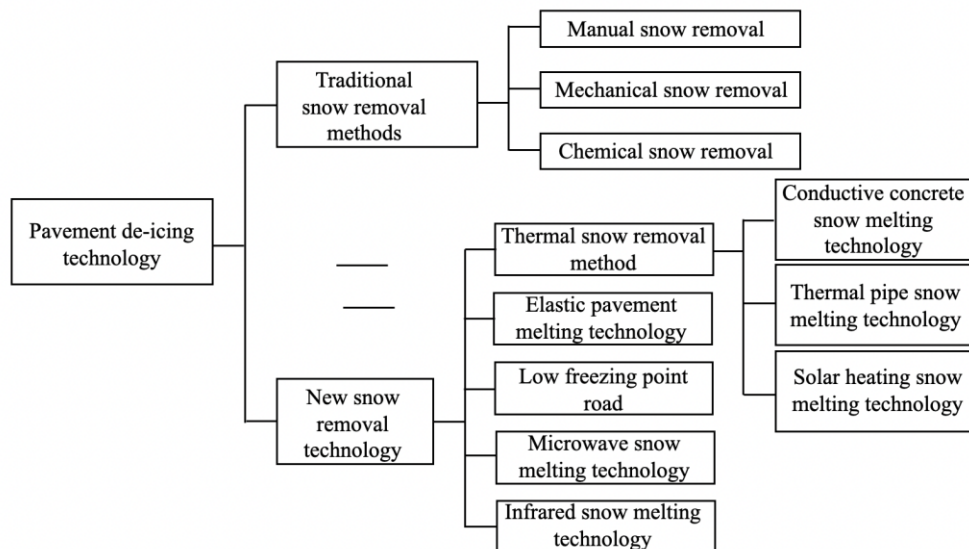


Figure 1 - Classification of snow removal technology

Based on some problems existing in the traditional snow removal technology, scholars actively research and develop new snow removal technology, and some progress has been made, including thermal snow removal method, elastic pavement melting technology, low freezing point road, microwave snow melting technology and infrared snow melting technology.

Thermal snow removal method: it mainly melts ice and snow with the help of the heat generated by solar energy, geothermal energy, hot water, electricity, etc., which can be subdivided into conductive concrete snow melting technology, thermal pipe snow melting technology, solar heating snow melting technology, etc. Conductive concrete snow melting technology is to incorporate conductive materials such as steel fibers and carbon fibers into concrete, and then set electrodes in a certain area, and then form a conductive grid to heat the road to achieve the purpose of snow melting, which can avoid the damage of deicing salt or mechanical snow removal to the road, but in order to achieve the snow melting effect, the current of the power grid will be very large, and a large magnetic field will be formed to affect driving safety. Thermal pipeline snow melting technology is to lay pipelines with a certain amount of heat liquid in the road, and then transfer heat to the road

surface to achieve the effect of snow melting, its early investment is small, and the energy source is extensive, but due to the need to lay coarser pipelines, it will form a stress concentration phenomenon in the road, and under the action of vehicle load, the heat pipe may be damaged, affecting the stability of the road structure. Solar heating snow melting technology is to transfer and store the heat radiated by solar energy in the subgrade soil under the road in summer and release it in winter to melt ice and snow. Its advantage is that green energy will not pollute the environment, low operating costs but its actual implementation is more difficult, the upfront investment is too large, and the cost performance is not high.

Elastic pavement melting technology is to add high elastic granular materials into the pavement materials, which will form a certain rough surface on the road after mixing with asphalt mixture. In ice and snow weather, the interaction between these rough surfaces and wheels can quickly break and melt the snow on the road, which has a more significant effect of removing ice and snow than ordinary pavement, and the pavement has better high-temperature stability, however, this technology is generally applicable to areas where the temperature is higher than -12 °C in winter.

Low freezing point asphalt pavement is to add low freezing point additives to the asphalt mixture in advance, so that it is gradually precipitated under the action of osmosis and capillary action to achieve the purpose of melting ice and snow. At present, there are two main ways to use the low-freezing point additive :when the new road is built, the additive is added to the asphalt mixture in the form of filler instead of mineral powder; Based on emulsified asphalt and other materials, modifiers and low freezing point fillers are added into the in-service pavement to prepare a low freezing point maintenance layer with snow melting and viscosity reduction functions.

Microwave ice and snow melting technology is to heat the position where the ice layer contacts the road surface, separate the ice layer from the road, and then use machinery to remove the ice and snow. Its advantage is that it does not need to melt all the ice and snow, but only needs to separate the ice and snow from the road, which greatly saves energy and does not damage the road surface. However, the speed of microwave ice removal is slow, and it is difficult to achieve the purpose of rapid ice and snow removal.

Infrared snow melting technology is based on the fact that the frequency of infrared ray is similar to the vibration frequency of ice and snow molecules, which can make the movement of ice and snow molecules become intense and the temperature rises to achieve the purpose of removing ice and snow. Its energy utilization rate is high and the removal of ice and snow is relatively complete, but the temperature rise is slow when the ambient temperature is low, and sometimes the purpose of melting ice and snow cannot be achieved.

**Conclusions.** The classification of snow removal technologies of highways is considered, the main advantages and disadvantages of the given technologies are revealed. Most often, a technologist using anti-icing salts is used. Further research is aimed at predicting the durability of asphalt concrete when exposed to anti-icing substances.

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