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ADDENDUM CURRICULUM VITAE
ON WINTER ROAD MAINTENANCE ISSUES

Since 1998, I have developed additional expertise in the area of winter road maintenance issues. Approximately 50% of my personal practice involves addressing issues related to the determination of the road condition, whether the road maintenance was appropriate for that condition, and what effect certain maintenance practices would have had on the previously determined condition. I have provided opinions with respect to the appropriateness of winter road maintenance activities (including meteorological issues) for both the plaintiff and defence in many jurisdictions across North America and indeed have been qualified by the courts to do so in Ontario, British Columbia, Washington, Oregon, Arizona, New York, and the Yukon. Certainly, most cases relating to winter road maintenance issues also require an in-depth accident reconstruction for the purpose of establishing how the drivers' behaviour (vehicle speed, steering, and braking) factors into the road surface friction (snow, ice, wet or dry). For pedestrian slip and falls, an understanding of the manner in which the tumble takes place often provides information on the surface walked on. While the determination of friction is an aspect of accident reconstruction that has been investigated since the early part of my career in 1985, the specific expertise in winter road maintenance has been gained by the following sources:

EDUCATION

The Bachelor of Mechanical Engineering received from McGill University in 1985 encompassed traditional engineering core courses, including heat transfer, thermodynamics, and fluid dynamics. These courses provided an understanding of how heat moves (conduction, convection and radiation), and also provided the means to calculate chemical properties of various organic and inorganic solutions. Since 1999, I have attended as a speaker, and also as a delegate, five week-long snow conferences, which have typically hour-long sessions on the specifics of snow and ice removal technology and related issues. These have included the Transportation Research Board (trb.org), Pacific Northwest Snowfighters (pnsassociation.org), Ontario Good Roads Association (ogra.org) and The Insurance Corporation of British Columbia among others. Topics have included equipment selection, chemical properties, weather forecasting tools, environmental issues, policy and management. For example, I was invited to the Ontario Good Roads Association's (OGRA) yearly symposium on snow and ice control to assist maintenance managers on how and why anti-icing and de-icing chemicals work and when and when not to use this very effective tool. It should be noted that OGRA is one of the largest provincial or state associations of winter road maintenance professionals. I have participated in and have been involved with the leading edge snow fighting group Pacific Northwest Snow Fighters having both performed testing for this group, lecturing to this group and attending their snow shows. I am also on the University of Iowa's Snow and Ice List serve. This is the world's largest Internet-based winter maintenance chat room, where pressing issues are posed on a daily basis and answered by individuals with experience in the area. It encompasses research personnel,

engineers and maintenance managers, primarily in North America and Europe.

In 2000, I completed a 4-month, 3-credit course at the Master of Civil Engineering level from the University of Iowa entitled "Winter Road Maintenance". This comprehensive course explored areas such as equipment selection, plough dynamics, cost benefit analysis, weather related issues, snow fence design, sanding techniques, liquid and solid chemical usage, personnel issues, and chemical phase curves. I received a final grade of 100% after completing an in depth analysis of a new device which was being considering for use in the industry with respect to reducing the amount of salt spread on the highway without loss of expected benefit (this entitled "Cost Benefit Analysis of an Automatic Granular Reduction Device for Pre-wetted Solid Delivery"). I am informed by Professor Nixon from the University of Iowa that this was the first 100% grade awarded since the course's inception.

RESEARCH

In 1998, we engineered and constructed what is thought to be the only climate-controlled friction test facility in the world. This chamber is capable of modulating temperature and humidity to one-decimal place accuracy, while simultaneously measuring friction on a test bed to a three-decimal place accuracy. It has the capacity to make snow, ice, fog and disburse liquid chemicals in prescribed amounts. Using this device, which is controlled independently via purpose-built computer software, we have been able to study in great detail the effects of applying liquid chemicals on both asphalt and concrete surfaces. In 1999, we were the first to determine that when a liquid dehydrates to form a solid precipitate, a reduction in friction of approximately 15% for most chemicals is seen. We are also leading researchers in the area of liquid chemical induced slickness, particularly as it relates to interaction with road contaminants, causing a reduction in friction. As a result of our research capability and experience, all liquid chemicals used in the Pacific Northwest (and the vast majority of chemicals used throughout North America) are required to be tested for friction properties in our laboratory, before they can be sold and used by any public agency. We completed a $100,000.00 USD research project, which aimed to study the effect of pre-wetting solid chemicals (i.e., road salt) upon application on both ice and snow surfaces. This research will enable the maintenance manager to quantitatively reduce the amount of road salt used when pre-wetting is undertaken, which will minimize salt loading on the environment, required as a result of Environment Canada reclassifying salt as potentially toxic.

INVENTIONS

As a result of the importance of road friction determination, we invented the world's first in-road friction measuring device, which is patent protected. This device lowers a small slab of concrete under the road surface and uses a rubber tire to measure the road surface friction. Based on the values received, a digital "Slippery When Wet" sign, also developed and built by us, inform drivers when friction values drop. Additionally, the value is linked with other road sensors, including moisture detectors, salinity sensors, temperature gauges, humidity sensors and wind speed indicators and this bundle of information is provided to a central maintenance facility

where important management decisions can be made. The development and testing of this product has required substantial interaction with other manufacturers of various sensor-related components and this has further increased my understanding of the relationship between ambient air temperature and road surface temperature, which we have the capability of charting, throughout North America, in approximately 400 different sites.

We have developed and commercialized a thermochromic plastic which can be embedded in the road surface, and which changes color as it approaches the freeze point. This technology will allow us to spell out warnings to the motoring public that the road surface upon which they are driving is frozen. The device was designed and developed by me as Founder/CEO of Traction Technologies Inc. Traction Technologies Inc. won the Telus - New World Ventures competition for best new business concept, largely as a result of the thermochromic plastic invention. The purpose of the thermochromic "puck" is to determine, conclusively, whether the road surface temperature is below freezing - a pre-requisite for black ice. Typically, road temperatures are similar, but distinct, from air temperatures, which typically are available from thermometers in present-day vehicles. As of January, 2006, 2,500 of the devices have been installed in Canada, the United States and Europe.

EXPERIENCE

As of 2015, I have investigated in excess of 1000 accident situations where the primary question posed was that involving winter road maintenance concerns. The American Federal Highways Administration also requested that I investigate approximately 50 incidents that had occurred nationwide relating to slickness caused by liquid anti-icing applications. In each of these incidents, the common denominator was a temperature of 45 - 50°F, and 45 - 50% humidity, and so it was necessary to closely review the meteorological data of each and every one of these cases very carefully. Indeed, our research has shown that the weather is the number one factor which must be addressed in winter road maintenance cases. I do offer on a routine basis (in essence in every case) the ability to determine what the road surface condition was based on the weather records that are provided to me. We rely on agencies such as Environment Canada and the National Climate Data Centre for example, to provide us this information. We also rely on data from various agencies that have Road Weather Information Systems (RWIS) and again, I also have expertise in using this weather data and extrapolating from this information, road conditions. Specifically, this includes ambient air temperature, road temperature, sub-soil temperature, and moisture accumulation. From my work in sensor technology, I have also developed expertise in determination of road surface temperatures based on elevation, distance from water bodies, and localized conditions.

In the area of winter road maintenance, clients include each and every chemical manufacturer, state DOT's, Plaintiffs, maintenance contractors and distributors. My practice is equally divided between Plaintiff and Defense clients.