NRC conducts train research

After more than 100 years, railways remain the backbone of long-distance freight transportation in Canada. Far from being outdated, they are extremely energy efficient, moving merchandise at about a fourth the energy cost of truck haulage.

In recent years, however, it has become clear that several aspects of rail transportation, particularly those of economy and safety, could benefit from new technological developments. Derailments, for example, still occur and pose very serious threats to human life, a fact made clear recently at Mississauga, Ontario involving a chlorine tanker car; the derailment forced the evacuation of a quarter-million people for several days. Such accidents have underscored the importance of research by the National Research Council's (NRC) Division of Mechanical Engineering and other interested organizations, including railway companies, equipment manufacturers and regulatory agencies.

Three of NRC's laboratories are actively involved in railway research: the western laboratory in Vancouver; the low temperature laboratory and railway laboratory, both in Ottawa.

Bruce Kane, NRC

A bird's eye view of NRC's railway laboratory at Uplands Airport, south of Ottawa.

Examines damaged wheels and rails

As Canada's main centre of expertise on tribology (the science of lubrication, friction and wear) the western laboratory examines the problem of wear and failure of rails and wheels. Canadian railway companies spend millions of dollars annually replacing wheels and rails damaged by wear, especially in curved sections of the track where rail corrugations – an effect similar to washboard patterns on poorly maintained dirt roads – are a serious problem.

During 1979, with the help of railway companies, the laboratory designed and built a special test simulator to measure rail-wheel wear effects. The computer-controlled simulator allows more rapid and economical investigation of the mechanical and metallurgical problems of rail-wheel interaction than full-scale field tests.

The Ottawa low temperature laboratory for the past 12 years, has worked on a problem of great practical importance to Canadian railways: how to keep track switches operational in winter ice and snow. In standard switches, the moving rails tend to compress snow or ice, thereby jamming them, and for the Canadian railway network with its largely single-track lines that require sidings, the failure of even one ice-blocked switch can cause considerable dislocation. In the past, railway switches were kept operational during snowstorms with shovels and brooms, a simple but slow and costly procedure.

The laboratory devised a switch protector that utilizes a high speed air curtain to prevent snow from falling on the switch. Following several winters of successful field trials, an Ottawa company is now licensed to produce commercial versions of the air curtain device.

More recently, the low temperature laboratory, working with the Division's Manufacturing Technology Centre, has developed another technique that depends on shearing action to keep switches operational; the switch simply scrapes ice and snow away. A two-year testing program at the St. Luc Yard of Canadian Pacific Rail, Montreal has indicated good results with the new device.

Wide range of test facilities

The railway laboratory (inaugurated officially in September 1978) has a wide range of test facilities and considerable expertise to place at the service of the Canadian railway industry. Canadian railway car manufacturers make extensive use of the laboratory's test facilities to ensure that their cars meet basic strength and safety standards. To be acceptable for interchange service between Canada and the United States, new railway cars undergo a series of "torture tests". This punishment includes being squeezed in a giant frame capable of applying forces up to a million pounds, and being struck repeatedly by a "hammer car" that is released from a steep ramp. Recently, Bombardier Inc. of Montreal, had its prototype of the new Light-Rapid-Comfortable (LRC) passenger car tested in the squeeze frame; the car satisfied strength requirements demanded by one user, AMTRAK, in the United States.

The wheels of existing railway cars are "fixed" on axles which do not steer during travel; hence, they do not negotiate curves easily and are often unstable at relatively low speeds. Undue wear on rail and car wheels thereby results, increasing the danger of derailment and driving up the costs of rail and wheel maintenance. These problems have spurred the development of full-scale track simulators in which the rail tracks are replaced by rotating rollers, the vehicle under test remaining stationary.

Such a facility is now being completed by the railway laboratory, and when ready, the simulator will handle cars up to 29 metres (95 feet) in length and 136 metric tons in weight and will be able to simulate speeds of up to 241 kilometres (151 miles) an hour. One of its unique aspects is a capacity to simulate curving track conditions, with a precision not available elsewhere. The new railway dynamic building also houses a vibration test section, enabling researchers to examine the dynamic properties and suspension characteristics of railway cars without their wheels turning, through the use of powerful, computer-controlled hydraulic shakers.

(Article by Michel Brochu in Science Dimension, *1980/3.)*