Economic Analysis of Pavement Impacts from Studded Tire Use in Alaska

PROJECT BACKGROUND

Alaska DOT&PF received a request from state legislators in 2016, asking for data regarding economic impacts to Alaska roadways from studded tires. Studded tires are a significant cause of pavement rutting in Alaska. Depth of ruts is measured to determine the "health" of pavement. Ruts greater than 0.4 inch are considered a safety issue in other states and is considered "Poor" using federal metrics. Rutting is a major issue in the high traffic volume areas of Southcentral and Southeast Alaska.

Over the years, DOT&PF conducted a number of studies to assess and quantify the effects of studded-tire use and to find methods to reduce the rate of pavement rutting. These methods and studies include:

- Using hard aggregate and improved mix designs (e.g. Stone Mastic Asphalt and Superpave mixes) helps minimize the rate of rutting. For example, instead of reaching a pavement rut depth of a half-inch in 5 years when using local "soft" aggregate in a mix, the use of "hard" aggregate and special mixes may yield a rut depth of a half-inch in 8 years, thus extending pavement life.
- Extracting and transporting hard aggregate from remote sources is cost-effective (e.g. from Cantwell to Anchorage by rail).
  http://dot.alaska.gov/stwddes/desmaterials/assets/pdf/hard_ashpalt_aggregate_study/6_final_cantwell_development_study.pdf
- Importing hard aggregate is cost-effective (e.g. from WA & BC to southeast Alaska by barge).
  http://www.dot.state.ak.us/stwddes/desmaterials/mattraining/assets/costeffectiveness_hma_0603.pdf

Since the mid-2000, it was observed that a number of factors have changed:

- Improved non-studded tire options and increased use of flexible studless tires (e.g. Blizzak tires).
- Increased use of lightweight studs on tires
- Increased studded tire use on bare pavement caused by warming winters.
- Improved pavement design using hard aggregate and stiffer, polymerized asphalt binders. The hard aggregate use policy can be found at:
  http://www.dot.state.ak.us/stwddes/dcspubs/assets/pdf/directives/2013/081413_hard_aggregate_policy.pdf

In summary, the use of hard aggregate and improved mix designs were able to improve but not eliminate studded-tire wear.

RESEARCH APPROACH

Staff worked with the Civil Engineering Department and Institute of Social and Economic Research at the University of Alaska Anchorage and used funding from the Federal Highway Administration to conduct research investigating the legislative request, which included:

- Completed literature review.
- Reviewed 5 years of studded tire tax data.
- Conducted cost review for 20 highway projects within Southcentral and Southeast Alaska.
- Reviewed winter tire options in Alaska.
- Conducted parking lot and household surveys.
- Analyzed life-cycle cost and road damage from studded tire use over past 20 years.

This project excluded quantifying cost benefits from safety related trade-offs of studded tires use versus rut depth, due limited project funding.

KEY FINDINGS

- Road damage from studded tire use in Alaska costs $203.2 million in 2019 USD over 20 years or $13.7 million/year.
- Effect of studded tires reduces the asphalt surface life from 15 years to 6–8 years, depending on traffic, location and type of asphalt mix used.
- Studded tires on passenger vehicles cause 237% more rutting than plastic deformation from same number of heavy trucks as shown on the figure below.
- Parking lot and household surveys show a percent studded tire use range between 35% (Anchorage) and 48% (Statewide) for personal vehicles.
- The survey results show a large gap in public awareness of non-studded winter tires options.
- The resurfacing cost associated with road damage from studded tires is 42 times more than the state's annualized studded tire tax revenue of $318,000.

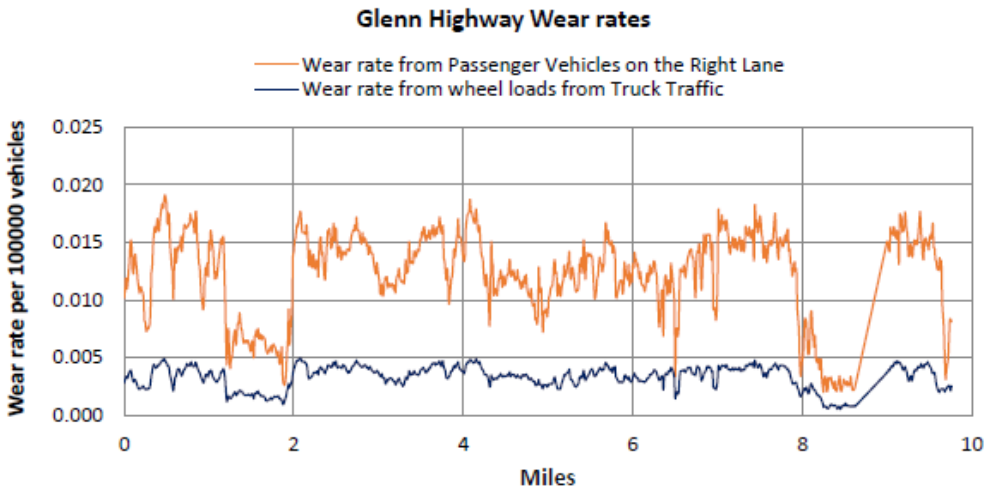


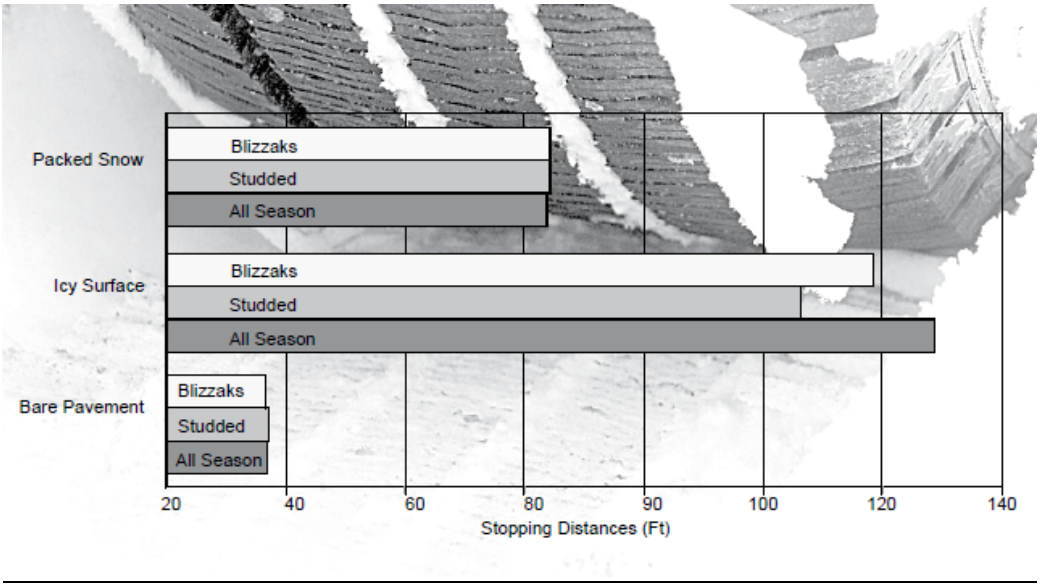
Figure 2.1 Distribution of wear rates for the Glenn Highway

THE FINAL RESEARCH REPORT LINK:

http://www.dot.state.ak.us/stwddes/research/assets/pdf/4000-175.pdf

PAST RESEARCH TELLS US WE HAVE OPTIONS

The precise environmental conditions under which studded tires provide a traction benefit over studless winter tires are rare. On smooth ice near the freezing mark, when studs are new, they perform well. As the temperature drops, or as the studs wear, their effectiveness diminishes. Studless or non-studded winter tires offer an excellent alternative. They are good on ice, great on snow, maintain similar performance characteristics as they wear, and are only slightly more expensive. All-season tires can provide good traction on snow and ice. However, on ice near the freezing mark they perform poorly when compared to studded tires or studless winter tires.



The chart above shows stopping distances at 25 mph. They are the average of a front-wheel drive car, a rear-wheel-drive pickup, and a rear-wheel-drive car. Traction performance can be characterized in many ways, including braking, acceleration, cornering, controllability, and grade climbing. Although all factors are important, the single best indicator of tire performance is braking distance and deceleration.

The test was conducted in Fairbanks at near-freezing temperatures. All three tire types performed well on packed snow surfaces. On ice, studded tires performed only slightly better than Blizzaks. On bare pavement, studded tires performed the worst.
https://www.wsdot.wa.gov/research/reports/fullreports/551.1.pdf

WHAT CAN THE STATE DO TO HELP REDUCE DAMAGE TO OUR ROADS?

Options include:

- Ban use of studded tires.
- Ban heavy metal studs. Switching to lightweight studs will reduce total pavement damage by 50% and increase total pavement life by 7-10%.
- Shorten the studded tire season by 2 weeks on either end, consistent with recently observed winter weather trends.
- Educate motorists about the safety benefits of non-studded winter tires such as Blizzaks.