Research Proposal

Pollution Prevention Through Automobile Design

Problem Title. Are there technical innovations in automobile design, such as electromechanical actuators in lieu of hydraulic cylinders, low copper brake pads, fuel cell technology, alternative body and chassis materials, gas/electric hybrid vehicles, biodiesel fuels, etc. that can have a measurable, long-term positive effect on highway stormwater quality?

Problem Statement. WSDOT has Clean Water Act obligations to reduce pollution in its stormwater runoff to the "maximum extent practicable". One of the most successful long-term improvements to highway stormwater runoff occurred because of the elimination of lead additives as an "anti-knock" agent to gasoline in the late '70s. Since the start of the prohibition of lead gas additives, median lead concentrations in highway runoff has decreased by more than an order of magnitude. Can other technical improvement in auto design and materials have promise for improving runoff quality? An associated question that could be addressed by this proposal:

Are these technical innovations economically and politically feasible?

Literature Search. No studies conducted by WSDOT. Automotive companies in general are not actively trying to improve fuel efficiency or make major changes in materials or designs to promote environmental objectives because their most profitable vehicles are large, heavy sport utility vehicles that use conventional technologies. There are several automobile design changes that may potentially have a significant positive effect on stormwater runoff quality if they are widely implemented:

Electromechanical accuators – Precludes the need for brake or transmission fluid lines, which leak regularly.

Low or no copper brake pads – Copper is a prime constituent in highway runoff and copper brake pad are a critical component of anti-lock brake systems because of copper's ability to maintain a relatively consistent friction coefficient. Studies in California have implicated copper brake pads as the major source of copper contamination in San Francisco Bay. Alternative materials in brake pads, such as ceramics or composite materials, may be able to replace the function of copper pads in anti-lock braking systems while improving runoff quality.

Hydrogen fuel cell technology – Combustion of hydrogen using fuel cells produce only water and carbon dioxide as end products. With auto exhaust being a prime contributor to pollutants in highway runoff, including heavy metals, this technology may have significant promise to improve highway runoff quality.

Alternative chassis and body materials – Auto chassis and bodies have always been constructed of galvanized steel coated with zinc-based anti-rust compounds. Zinc is also one of the primary constituents of concern in highway runoff. Use of alternative materials or non-zinc anti-rust coatings may be able to greatly reduce zinc concentrations in highway runoff, although its economic feasibility may be questionable.

Gas/electric hybrid vehicles – Three hybrid vehicles are currently on the market and many more are in the planning stage. At low speeds, the hybrids use an electric motor to power the vehicle and changes over to a conventional combustion engine at higher speeds. The result is significantly higher fuel economies with the added benefits of less exhaust that can cause air and stormwater quality problems.

Biodiesel fuels – Conventional diesel engines can be easily modified to burn "biodiesel", a fuel synthesized from vegetable oils and greases without adversely affecting engine performance. These fuels contain very low concentrations of heavy metals, unlike conventional diesel fuels, which may help improve highway runoff quality if used widely.

Research Methods. Investigate the feasibility of converting ferry engines or fleet vehicles to use biodiesel as a pilot study. At national transportation-related conferences, promote applicable research efforts on developing "Eco-auto" technologies that have promise to improve emissions or stormwater runoff quality.

Partnering Opportunities. Low. Any progress in this field would involve the cooperation of auto companies. These topics are likely to become overtly political because of the possible economic impact to politically influential automobile companies, oil companies, and labor unions.

Estimate of Costs and Research Duration. Estimated costs have not been developed, but are expected to be greater than $100,000.

Urgency, Payoff Potential, and Implementation. Long-term payoff potential if additional source control methods are identified and widely practiced. However, as mentioned above, implementation of these methods could difficult due to political and economic concerns.

Research Proposer

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