To Idle or Not To Idle: That Is the Question

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Abstract

Should I idle my car to warm it up before I drive? Should I shut the engine off while waiting to pick up a passenger or for a train to go by? Is it better to pick up food at a drive-through or to park and go into the restaurant? These are common questions that people ask when they want to know more about how to drive "green." There are conflicting answers in the literature, which has led to confusion. This poster presents the results of measurements performed on both diesel and gasoline passenger vehicles at Argonne National Laboratory. The answers are found to depend on vehicle type, ambient temperature, time, local laws, and what criteria are used to define "green."

This poster also introduces elements of a new initiative designed to provide clear information to those who have not yet gotten the word that idling reduction is a win-win proposition.

Background

Idling reduction efforts have focused on heavy-duty diesel vehicles because they are the low-hanging fruit of fuel economy and emissions reduction. Long-haul trucks often idle overnight to keep the driver comfortable; our previous work has identified and compared lower-impact alternatives to overnight idling. We have also identified work-day idling by all classes of vehicles as a significant waste of petroleum and source of excess emissions. And the EPA's large and visible program to reduce emissions from school buses includes a component on idling reduction. But many people ignore passenger car idling—even at schools—as a source of emissions and wasted fuel. **If each car in the United States idles just 6 minutes per day, about 3 billion gallons of fuel are wasted annually, costing drivers $10 billion.** And they haven't gotten anywhere!

Although it is desirable to get into a comfortably toasty or cool car, not overdoing a 10-minute remote warm-up or cool-down is the goal. Running a car for that period is still idling, and neither the engine nor the catalyst is at its peak operating temperature. Additionally, in some jurisdictions, idling an unattended vehicle is illegal.

Major vehicle manufacturers and suppliers hold the view that idling modern engines is not only unnecessary but undesirable. Owner's manuals often advise against idling and encourage "ecodriving" as a way to increase fuel economy and reduce emissions. In addition, DOE, DOT, and EPA discourage unnecessary idling, and DOD attempts to reduce idling to limit fuel costs and engine wear.

We found inconsistent and conflicting recommendations, with no supporting scientific data, in anti-idling literature distributed across North America. One fast-food chain claimed that it was "greener" to use the drive-through than to park and go into the restaurant. Argonne, therefore, decided to measure idling fuel use and emissions for light-duty vehicles, and to compare these to start-up emissions to enable data-based decision-making about idling.

Measurements

To answer questions about when it makes sense to idle rather than turn off the engine, and whether to warm up the car by idling before driving, Argonne set out to measure start-up emissions, idling emissions, and the time for the catalyst to warm up and cool down vs. outside temperature. Preliminary results are presented here.

Figure 1. A 2009 VW Jetta TDI undergoing testing at Argonne's Advanced Powertrain Research Facility.

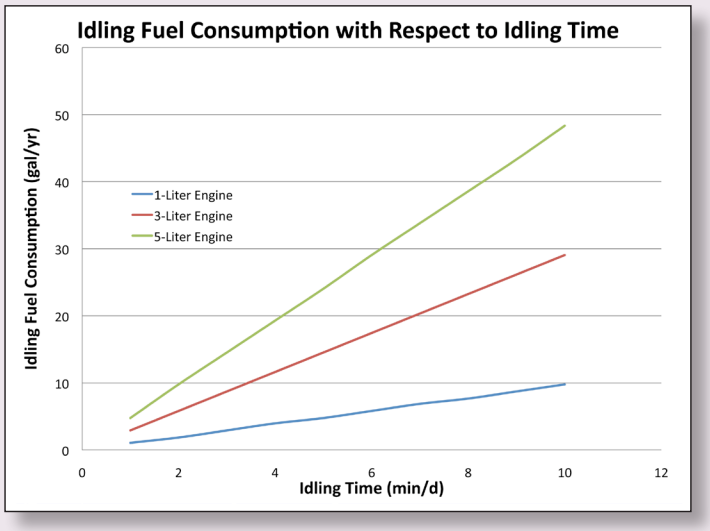
The first car to be instrumented was a 2009 VW Jetta TDI (Figure 1), which is a 50-state compliant, Tier 2 Bin 5 vehicle with a complex aftertreatment system that includes a diesel oxidation catalyst (DOC), a particulate trap, and a nitrogen oxide (NO_x) trap. The engine controller was monitored to record engine speed, coolant temperature, and vehicle speed. In addition, thermocouples were placed before and after the aftertreatment devices. Because of the lack of an available temperature chamber, we relied on ambient conditions. A 2010 Ford Focus was instrumented in the spring; low-temperature measurements will be taken on this vehicle later this year. Measurements on several additional vehicles, including some light trucks, are also planned.

For the measurement of cold-start times, each vehicle was left outdoors overnight. The following morning, the vehicle was started, and the time for it to reach operating temperature was recorded. Next, the vehicle was driven until the temperatures stabilized, and then it was shut off. The time until the vehicle became "cold" was recorded.

For the measurement of cold-start emissions, the vehicle was "cold soaked" outdoors overnight and then started. Emissions were recorded until the vehicle reached operating temperature. The procedure was repeated after a hot soak (i.e., the aftertreatment system had cooled down, but the engine coolant was still warm).

In Figure 2, we see that idling fuel consumption is, of course, linear with time, and increases with engine size. Accessory loads also increase fuel use; we plan to take future measurements with the vehicles' heating and air-conditioning systems running.

Figure 2. Idling fuel consumption with respect to time. (For reference, the Honda Civic engine is a 1.8 liter, the Ford Fusion a 2.5 liter, and the Chevrolet Malibu a 3.6 liter.)



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Measurements (continued)

Figure 3 summarizes preliminary information on warm-up and cool-down times for the catalytic converters on the Jetta and Focus. We see that warm-up times decrease and cool-down times increase as the temperature rises. In temperate weather, the gasoline vehicle's catalyst is ready to work immediately on hot start, but it takes about a minute at idle. In general, the diesel vehicle's catalyst warms up more slowly than the gasoline vehicle's. Next, we see that the catalysts warm up much faster when the car is being driven than when it is idling, thus driving rather than idling at start-up minimizes start-up emissions as well as fuel use and CO_2 emissions. This is true for both hot and cold starts. The diesel's catalyst takes about 2 minutes longer to warm up at 32˚F; in fact, when the temperature drops near 0˚F, the diesel's catalyst may never actually warm up when idling from a cold start.

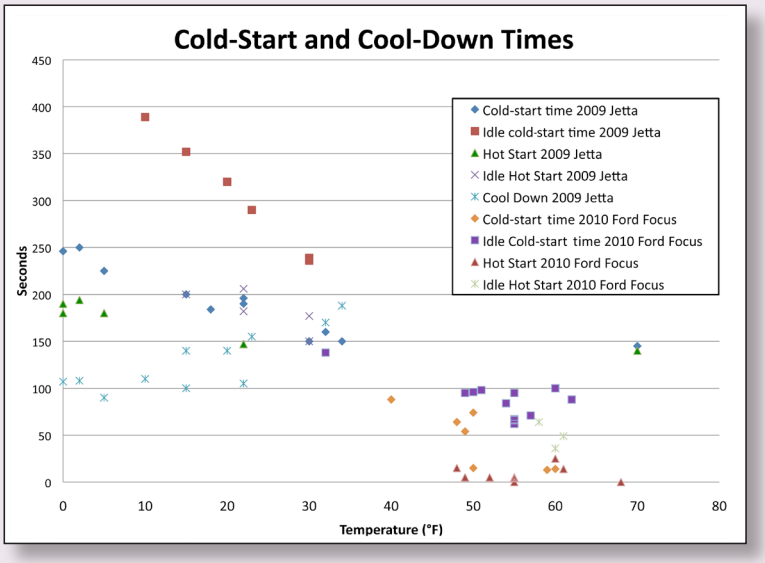
Cold Starts. Vehicle was cold soaked overnight, started, and driven immediately.

Idle Cold Starts. Vehicle was cold soaked overnight, started, and idled until the exhaust temperatures reached 200°C or equilibrium.

Hot Starts. Vehicle's engine was at operating temperature, turned off, cold soaked for 15 minutes, and then started and driven immediately.

Idle Hot Starts. Vehicle's engine was at operating temperature, turned off, cold soaked for 15 minutes, and then started and idled until exhaust temperatures reached 200°C or equilibrium.

Figure 3. Cold-start and cool-down times.



Preliminary Recommendations

For all cars, the catalytic converter warms up much faster when the car is being driven than when it is idling. In other words, idling a car that's been "cold started" means that harmful emissions are not being removed from the exhaust. And the driver is getting 0 mpg! For diesel vehicles at temperatures near 0°F, the catalyst may never be brought up to light-off temperature by idling, so use remote-start features sparingly, especially if you drive a diesel vehicle.

Conclusion: You don't need to idle to warm up your car. If you turn off your gasoline-powered car for as long as 15 minutes while you run an errand, the catalyst will be ready to work again as soon as you restart your car. There are no emissions or fuel use during that period, and no excess emissions on start-up. If you have been inside so long that the catalyst is cold, there will be start-up emissions, but emissions and fuel use from idling will have been avoided. If you idle at the drive-through, you burn fuel, and CO_2 and other emissions are produced. If you want to minimize your carbon footprint, park and go in. If your trip is brief, the catalyst will still be warm enough to prevent start-up emissions when you restart your car.

Caution: There are times when you must idle your engine for safety, such as in traffic (unless you drive a hybrid). And if you must leave a passenger in a car on a hot day, please leave the air-conditioning on.

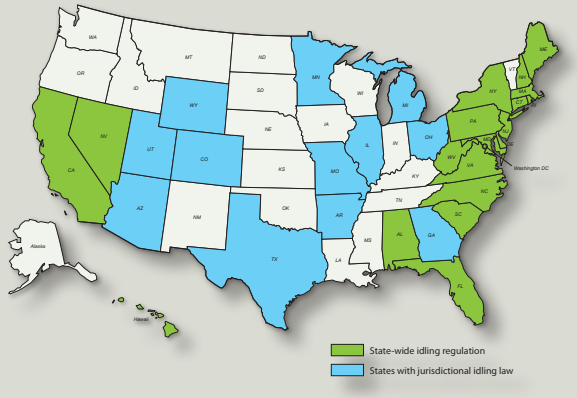
A National Idling Reduction Campaign

We are developing educational materials to be shared with Clean Cities Coalitions and other entities interested in spreading the word about the benefits of idling reduction (Figure 4). The materials are intended to be useful for drivers of light- and heavy-duty vehicles, both fleets and individuals.

Figure 4. Argonne is developing educational materials for an idling reduction campaign.

Idling is more than a matter of emissions and wasted fuel; states, counties, and cities are passing laws to limit the amount of time vehicles of all types may idle (Figure 5). Passenger vehicles are increasingly the target of these laws.

Figure 5. States with idling regulations.



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