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Oak Ridge National Laboratory Sustainable Campus Initiative

ORNL Operations Best Practices Guide: Idle Reduction

ABSTRACT
The ORNL Sustainable Campus Initiative, working with the local DOE Clean Cities program, has created an idle reduction guide for use on campus that explains the benefits of reducing idling such as reducing harmful emissions and fuel and cost savings. One of the highlights of the guide is a collection of vehicle manufacturer recommendations directly from the owner's manuals of passenger vehicles and medium and heavy duty trucks and vans. For example, there is a long held belief that it is better to idle diesel vehicles in cold weather than to restart them, which according to vehicle manufacturers is no longer the case. In addition to the new idle reduction guide, new signage promoting energy and cost savings and emissions reductions through reduction of idling time will be implemented around the campus.

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ORNL Operations Best Practices Guide: Idle Reduction

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Overview

The Oak Ridge National Laboratory (ORNL) Sustainable Campus Initiative and ORNL Fleet Management have partnered over the years to work toward having the most sustainable vehicle fleet possible while meeting the mission goals of the Laboratory. One of the primary objectives of ORNL's Fleet Management is minimizing the amount of petroleum energy used in transportation at the Laboratory. This has been accomplished by using renewable fuels such as E85 and B20[1] in gasoline and diesel vehicles. Other management practices that work toward this goal are the replacement of older, less fuel efficient vehicles with newer vehicles that are more fuel efficient such as hybrid-electric vehicles and those that can use alternative fuels such as flex fuel vehicles.

Maximizing fuel efficiency (and minimizing petroleum use) within the ORNL fleet, or any fleet, is accomplished through a combination of vehicle technologies, the use of alternative and renewable fuels, and maximizing miles per gallon (MPG). Along with carpooling and trip reduction, eliminating all unnecessary idling is an important behavior that has many benefits to the Laboratory. Idling results in 0 MPG because during idling the vehicle is not moving but continuously using fuel. (It should be noted that a nonmoving vehicle in which the engine is being used to drive an auxiliary, such as a bucket truck, is not considered to be "idling".)

While idling recommendations for some light-duty (LD), medium-duty (MD) and heavy-duty (HD) vehicles can be obtained from manufacturers or other sources, sometimes that information is misstated or inaccurate, depending on the source. Additionally, drivers of all size vehicles have used personally relayed recommendations that are widely misleading. Often drivers believe or assume that leaving vehicles running is the best thing for the engine when in fact idling for very limited periods or not idling at all is what is recommended by the manufacturer.

Common myths about idling:

- Idling is more efficient and uses less fuel than turning the engine off and on again
- Turning the engine off and on is hard on the starter
- Idling is the best way to warm up the engine, especially in cold weather
- Idling does not cause damage to a vehicle's engine

One common complaint of drivers is that detailed information on idling recommendations for a wide variety of engines and vehicles is lacking. While idling recommendations for some light-duty, medium-duty and heavy-duty vehicles can be obtained from manufacturers or other sources, sometimes that information is misstated or inaccurate, depending on the source. Additionally, drivers of all types of vehicles have used informal recommendations that are widely misleading. One of the purposes of this guide is to summarize the best recommendations available on idling for LD, MD and HD vehicles. The

[1] E85 is a gasoline-ethanol fuel blend with up to 85% ethanol; B20 is its diesel counterpart, a diesel-biofuel blend with up to 20% biodiesel.

following recommendations summarize a collection of more than 120 vehicle manuals covering a range of vehicle types.

Light-Duty Idling Summary

- Avoid idling for long periods of time
- Idling beyond 30 seconds is excessive and should be avoided
- Extended idling wastes fuel and causes reduction in fuel economy
- Excessive idling can create engine wear and carbon soot buildup in the engine and components
- Excessive idling can affect the life of engine oil
- At start-up: idle for 0-25 seconds and drive gently to warm the engine (as recommended in manual)

Medium-Duty Idling Summary

- Avoid excessive idling (Idling beyond 5-15 minutes is excessive)
- Extended idling wastes fuel and causes reduction in fuel economy
- Excessive idling can create engine wear and carbon soot buildup in the engine and components
- Idle time at cooldown is only required if vehicle operated under extended, high power conditions (as recommended in manual)

Heavy-Duty Idling Summary

- Avoid excessive idling (idling beyond 5-15 minutes is excessive)
- Avoid idling for more than 3-5 minutes at start-up
- Extended idling wastes fuel and causes reduction in fuel economy
- Excessive idling can create engine wear and carbon soot buildup in the engine and components
- Idling produces sulfuric acid which can eat into engine surfaces and components
- Idle time at cooldown is only required if vehicle operated under extended, high power conditions (as recommended in manual)

Idling is occasionally necessary, as in the case of some delivery trucks, waiting in a slow-moving line, or extreme weather. However, most idling is unnecessary and can be eliminated simply through conscious effort. Some manufacturers do recommend a very short warm-up or cooldown period, but only if a vehicle has been under high power operation. Generally speaking, more than 5 minutes of idling is excessive and should be avoided.

The harmful emissions that idling creates should also be considered. These emissions include nitrogen oxides, carbon monoxide, carbon dioxide, and particulate matter [1]. Some of these pollutants pose health threats on their own, and some will come into contact with heat and sunlight to form ground level ozone, a potent pollutant that can worsen asthma and respiratory issues, and cause reduced lung function. Ground level ozone is especially harmful to children, the elderly, people who work or exercise outside, and people with existing lung problems [2].

Many manufacturers also state that engine oil can be affected by extended idling because oil becomes contaminated which results in a decrease in the oil life and increase oil change frequency. In addition to increased engine wear and tear, idling should be avoided for other important reasons. There are other equally important reasons to avoid unnecessary idling. Vehicles get 0 MPG and fuel is unnecessarily wasted while idling. This wasted fuel can be costly over the course of a year, especially for fleets. The

amount of fuel wasted will vary from vehicle to vehicle and depends on a number of factors. However, a rule to remember is that the larger the engine, the more fuel will be wasted while idling [1].

The following section provides more detailed information on these issues and further discussion on the benefits of reduced idling.

Idle Reduction Research and Practice

Technologies and regulations in place to prevent unnecessary idling

A considerable amount of research has been conducted on the fuel economy penalty associated with idling, the emissions and associated health risks, and the costs resulting from idling [1, 2, 3]. Based on these findings, state and local governments across the United States have enacted many anti-idling regulations. The American Transportation Research Institute keeps an up-to-date compendium of idling regulations enacted by state, county, or city codes [4]. For example, under New York State law, idling HD trucks and buses for more than 3 consecutive minutes can result in fines ranging from $250 to $15,000 [5]. Idling can be categorized as idling to warm the engine (including warming the passenger cabin), idling while waiting (non-traffic), and idling in traffic [6]. All but the last case involve driver behavior. Idling in traffic can be reduced with technologies such as start/stop with hybrid or newer vehicles, but it is often recommended that drivers not actively turn off vehicles in traffic situations because of safety concerns.

Newer vehicles do not need to idle

It is a common misperception that vehicles, especially diesel vehicles, need to be idled [6]. One common misconception related to diesel vehicles is that they need to idle, particularly in cold weather, to avoid difficulties restarting them. Many engine manufacturers say this is in fact not the case for newer diesel vehicles, which have new technologies in place to eliminate the need for idling, and because newer diesel fuels have been formulated to avoid gelling problems. There are a number of add-on devices that can eliminate the need to use an idling engine to warm up the cab of a vehicle in cold climates. These devices use electrical resistance heating or even portable power generating units that are far more efficient than an idling engine. Manufacturer statements from Ford [7] indicate excessive idling on the 6.0L Power Stroke diesel is harmful to the engine and increases maintenance. Ford and other manufacturers have an available option to meet California Air-Resource Board anti-idling regulations that automatically shuts the engine off after 5 minutes of continuous idling [8].

In a recent collection of statements from many LD, MD and HD vehicle and engine manufacturers, the vast majority recommended that drivers should avoid excessive idle time and idle only if absolutely necessary. LD vehicles are ready to be driven at start-up; however, MD and MD vehicles do not need long warm-up periods either. Echoing Ford statements on the 6.0L Power Stroke engine, many manufacturers stated idling can be damaging to engine and vehicle components. Cold engines have difficulty distributing oil. Idling can produce sulfuric acid, which can eat away at the engine and other components. Additionally, idling can contribute to incomplete combustion, which produces carbon soot, creates buildup in the engine, and causes unnecessary engine wear. The main takeaway points from OEM statements on LD, MD and HD vehicles are (1) idling can damage the engine and engine components and (2) drivers should avoid idling whenever possible, in all vehicles.

Costs of idling

Idling a HD diesel vehicle results in fuel consumption of around 1 gallon of diesel fuel per hour of idle time. Idling LD gasoline passenger vehicles consumes between 0.2 and 0.5 gallons of gasoline per hour depending on the size of the engine, with larger engines using more fuel during idle.

The following example shows a conservative estimate of the costs of idling in a HD vehicle only 1 hour a day over the course of a year.

1 Hour idling = 1 gallon fuel = $3.80
1 hour idling/day × 5 days/week = 5 hours/week × $3.80/hour =$19/week
50 work weeks/year × $19/week = ***$950/year (per vehicle) = 250 gallons fuel (per vehicle)***

The values in this example are approximate but serve to demonstrate how quickly the cost and fuel usage associated with idling add up. By one estimate, the annual US fuel consumption that can be attributed to idling due to warming and waiting could be as high as 1.8 billion gallons. (To find out more about idle reduction technologies for HD vehicles, see [9], which includes a worksheet that will calculate potential savings using idle reduction techniques.)

Greenhouse emissions from idling

Greenhouse gas (GHG) emissions from transportation are directly tied to the amount of fuel used: the greater the fuel economy, the lower the GHG emissions, namely CO_2 from fuel combustion. This means that idling increases the GHG emissions from vehicles as it lowers miles per gallon of fuel. Using the Argonne GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) model, the GHG emissions per gallon of diesel fuel consumed are 20.2 lb CO_{2eq}[2]/gallon of diesel fuel and 19.6 lb CO_{2eq}/gallon of gasoline. For the above example with a heavy duty vehicle idling 1 hour per day, the annual GHG savings would be around 5050 lb of CO_{2eq}.

Health impacts from idling

At ORNL and many other fleet locations, idling vehicles are often located near buildings and because of this, people may be exposed to harmful and irritating pollution, including particulate matter, unburned hydrocarbons, and, in some cases, significant quantities of carbon monoxide. Newer exhaust aftertreatments, including three-way catalysts for gasoline vehicles and diesel oxidation catalysts and diesel particulate filters on newer diesel vehicles, are most effective when the device is warmed up through normal vehicle operation and the engine is under load [10]. These devices perform poorly under cold engine idling conditions, which can result in increased levels of harmful tailpipe emissions. For example, benzene and 1,3 butadiene have been shown to be carcinogenic to humans, while particulate matter has been linked to increases in cardiovascular deaths [11]. Idling emissions are often considered more harmful than those from moving vehicles because the pollutants cannot be dispersed by the wake created by a moving vehicle [12]. Research has shown negative impacts on drivers from idling, including reduced in-cab air quality (known as self-polluting) and increased hearing/noise concerns, especially with HD and MD diesel vehicles [13].

Driver behavior

Research has shown that with appropriate policy interventions driver behaviors, such as idling, that lead to reduced fuel economy can be curtailed [6]. Research has also shown that drivers tend to underestimate the time they idle personal vehicles [6]. Previous studies have shown that external factors, including visual reminders, reassurance that shutting off engines is recommended, and awareness of cost savings and pollution reduction, can have a positive effect on influencing driver behavior when it comes to idling [14].

[2] CO_{2eq} is a measure of GHG emissions in terms of global warming potential as measure in CO_2 equivalence

Conclusions

This idle reduction guide outlines the benefits to promoting idle reduction best practices in terms of reducing GHG emissions, fuel use and cost, and maintenance costs and improving employee health and well-being at ORNL.

- Most idling is unnecessary and can be eliminated simply with a conscious effort
- Engine manufacturers consistently recommend against all unnecessary idling
- Newer diesel vehicles do not need to be idled for restart considerations
- Idling reduces fuel economy and increases fueling costs
- Idling cold engines can result in increased wear and maintenance costs
- Idling increases GHG emissions
- Idling emissions are often considered more harmful than those from moving vehicles

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