

Compatibility of blending A20 fuel into gasoline-powered engines in Indonesia

Indonesia's Ministry of Energy and Mineral Resources is considering blending 20% by volume alcohol, or A20, into gasoline to reduce gasoline imports and enhance energy independence. This gasoline-alcohol blend would be comprised of 80% gasoline, 15% methanol, and 5% ethanol by volume and would be sold throughout Indonesia's gasoline market, including Pertamina's Premium (RON 88), Peralite (RON 90), and Pertamax (RON 92).

Although the introduction of A20 blends has the potential to improve vehicle performance in some ways, our survey of literature shows there are compatibility issues associated with blending A20 into Indonesia's gasoline engine market and fueling infrastructure. These come with serious risks for Indonesia's light-duty vehicles, two- and three-wheelers, and several kinds of small equipment with a gasoline engine. The risks can be reduced, however, with certain measures in the fuel supply chain.

KEY FINDINGS

A20 blending can improve performance in the following ways:

Improved knocking resistance: Methanol's octane rating is higher than gasoline and this makes methanol better at resisting detonation or knocking. Knocking occurs when there is premature and uneven combustion within the engine and can result in damage to a vehicle's piston and cylinder walls.

Improved power and torque: Methanol-blended fuel can increase power and torque in vehicles that can adjust the combustion air-fuel-ratio (AFR). This includes most newer vehicles and two- and three-wheelers equipped with oxygen sensors, and during open-loop operation. Greater power and torque are desirable because they enable faster acceleration at all speeds, higher maximum speed, and the ability to bear larger loads. However, because older vehicles and small engine equipment are often unable to adjust the AFR to account for methanol's high oxygen content, power and torque can decrease in these engines.

Improved combustion emissions: Methanol's high oxygen content and lack of carbon-to-carbon bonds tends to result in cleaner, more efficient, and soot-free combustion. With methanol-gasoline blends, hydrocarbon (HC) and carbon monoxide (CO) emissions typically decrease, and nitrogen oxide (NO_x) emissions can vary.

A20 blending also brings with it the following risks:

Reduced volumetric energy content: Methanol contains about half the energy of gasoline per unit volume. This means that a tank filled with methanol-blended fuel achieves a shorter driving range than the same tank filled with gasoline. At the same time, methanol combusts more efficiently, and this partly compensates for its reduced energy content. Still, though, methanol results in higher fuel consumption per unit distance than gasoline fuel.

Increased risk for phase separation: Phase separation occurs when there is excessive water in the fuel. Alcohols are prone to phase separation because they mix easily with water. Phase separation is undesirable because corrosivity will increase in the alcohol-water layer. The gasoline-concentrated layer might also have a lower octane rating due to its reduced methanol concentration. Phase separation can result in extra service and repair costs for both retail fuel stations and vehicle owners.

Increased vapor lock risk: Blending methanol with gasoline will increase the volatility of the fuel and lead to increased fuel vaporization. Excessive fuel vaporization is problematic because vapors can block the vehicle's fuel line and could result in vehicle hesitations, surges, shaking, and stalling.

Increased corrosion of metals and alloys: Alcohols are more corrosive than gasoline. Corrosion in vehicles is undesirable because engine components are weakened, have a shorter lifespan, and are prone to failure. Excessive corrosion can result in clogged fuel filters, fuel pump failure, malfunctioning fuel level sensors, or clogged carburetor jets. High temperatures and water contamination, the latter of which is more likely under Indonesia's humid conditions, generally increase rates of corrosion. Corrosion could result in extra service and repair costs for retail fuel stations and vehicle owners.

Increased degradation of elastomers: Elastomers and polymers are present in seals, fuel lines and hoses, filters, tubing, and hose covers. When exposed to methanol, polymers and elastomers (i.e., elastic polymers) can swell and their physical properties, including tensile strength, weight, hardness, and elasticity, might change. High aromatic content in base gasoline can also increase rates of elastomer degradation. This could also lead to higher repair costs.

STEPS TO REDUCE RISK AND PROMOTE SUCCESSFUL A20 BLENDING

Several countries, including China, Israel, Italy, and Australia, have had success in testing methanol-gasoline blends in vehicle fleets. In evaluating such fleet trials and on-road tests, we identified a few crucial steps that could enable successful use of A20 in vehicle fleets.

1. The base gasoline should be of high quality and have low sulfur and aromatic content. It should also have minimal contaminants such as water and particulates. Most of the gasoline sold in Indonesia today has relatively high sulfur and aromatic content, and thus new efforts to reduce sulfur content are critical.
2. To prevent contaminants from entering the fuel during distribution, fueling infrastructure should be updated so that fuel hoses are new, storage tanks and pipelines are well-sealed, materials are compatible with alcohol, and fuel hose filters are fine enough to capture particulates. These measures are especially important in Indonesia because the high-humidity climate increases the likelihood of water contamination and phase separation.

3. Because methanol-gasoline blends tend to be incompatible with older vehicles and small engines, countries that offer methanol-gasoline blends should also continue to sell pure gasoline to reduce performance issues.

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Authors: Abigail Martin and Jane O'Malley

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Contact: Jane O'Malley, j.omalley@theicct.org

www.theicct.org

communications@theicct.org

[twitter @theicct](https://twitter.com/theicct)

