New Advancements in Flex Fuel Technology
By Alfred Szwarc

The historical launch of the Volkswagen Gol Total Flex car in March of 2003 marked the introduction of Flex-Fuel technology in Brazil. There is no doubt that this fact represented a new development cycle for Brazilian automotive engineering and, more importantly, a new growth period in terms of ethanol use.

Flex-Fuel technology is here to stay. Currently, of every 100 light vehicles sold in the country, 88 use the technology. All other vehicles are gasoline (6.9%) and diesel (4.4%) versions. In the gasoline vehicle segment there are some models manufactured in the country that in the short term will end up adopting the flex concept, and we have imported vehicles equipped with gasoline engines.

There are different reasons for the popularity of flex vehicles: unlike vehicles that run on a single fuel, they offer the consumer a variety of options and advantages: a choice of the cheapest fuel, a fuel more appropriate to one's driving characteristics and a reduction in environmental impact. Their popularity facilitates reselling in the used car market, with better resale values.

Apart from Brazil, flex vehicles exist in other countries. Currently, some 17 million vehicles of this kind are on roads around the world, of which 8 million in the United States, 8 million in Brazil, 600,000 in Canada, 300,000 in Sweden and a few thousand more spread over several countries (France, United Kingdom, Germany, Thailand, etc.). However, only in Brazil do these vehicles run on 100% ethanol (E100). In all other countries, the limit for use of renewable fuel is 85% (E85), due to cold climates and the absence of an auxiliary cold-start system. However, this limitation's days may well be numbered, thanks to a new cold-start system launched this year by Volkswagen do Brasil in the Polo E-Flex car and known as Flex Start, which allows starts in outside temperatures of less than 5ºC. Obviously, this system will have to be adapted to even lower temperatures in colder countries, but the technological progress achieved is important to illustrate the idea's feasibility. Apart from not requiring the little auxiliary gasoline tank, from which gasoline is injected into the engine to start it when temperatures drop below 18ºC, the new system also allows for a reduction of up to 40% in the emission of pollutants, while providing improved overall driveability.

Flex vehicles have received improvements ever since they were introduced in the country. Several models already have larger fuel tanks, increasing autonomy by about 10% and reducing the number of refueling stops. There have also been noticeable gains in efficiency. While the first generation of flex vehicles consumed 30% to 35% more ethanol than gasoline to cover the same distance, the current generation shows a drop in that difference, to the 25% to 30% range.

This is happening partly because of a change in outlook by some automakers that have realized there is a clear consumer preference for ethanol and have begun to optimize their engines for the renewable fuel. Whereas the first flex vehicle generation was developed from gasoline powertrains that could also run on ethanol or mixtures of the two fuels, the current generation has increasingly more vehicles

developed for preferential use with ethanol, although still capable of operating with gasoline or a mixture of fuels. Evidently, optimizing an engine for two fuels with physical and chemical differences is no simple task and involves costs, so that some compromises in engine design end up being adopted. This limits greater optimization for ethanol.

In other countries, there have also been advances in Flex-Fuel technology that may be adopted in Brazil. Swedish auto manufacturer SAAB developed a flex engine version equipped with a variable and "intelligent" turbo engine air intake system. Depending on the ethanol content, there is an increase in the operation pressure of the turbocharger, which virtually increases the engine's compression ratio and allows for considerably improved performance.

In the US, the flex engine is being developed to operate in hybrid vehicle versions that operate with an internal combustion engine and an electric engine. The Ford Escape prototype, recently presented to the U.S. Department of Energy, consists of a 4-cylinder flex engine assisted by a pack of 10 kW ion-lithium batteries. When fully charged and running exclusively on electricity, the vehicle's autonomy reaches 48 kilometers.

When the battery load reaches 30% of its capacity, the flex engine automatically starts functioning. The manufacturer states that the vehicle runs 37.4 km/l in urban use and 21.3 km/l in highway operation. In this type of vehicle, it is common for city mileage figures to be better than highway results, because the vehicle operates mainly on battery power when used in urban areas. As for emissions, the manufacturer says that if the fuel used is gasoline, there is a 60% reduction in relation to a conventional vehicle running on this fuel, and if the fuel is E85, the reduction reaches 90%. Given that consumption tests are performed in a lab, following a standard procedure, actual consumption figures may vary.

In March of 2009, flex fuel technology was also incorporated into two-wheeled vehicles. Honda, the world's largest manufacturer of this kind of vehicle, introduced the world's first commercial version of a flex motorcycle at its industrial plant in Manaus. The CG Titan Mix is equipped with a 150 cc engine plus several innovations compared to the previous, gasoline-powered model. These include electronic fuel injection and a catalytic converter, which result in reduced consumption and significantly lower emissions compared with emission levels adopted in 2009 in the European Union. Albeit on the market for only a short period, the flex version is already a success, as confirmed by the manufacturer itself.

At its launch, production plans for the CG Titan Mix called for a 50-50 split between gasoline and flex models. Three months later, the company revised its plan and the output became 65% flex and 35% gasoline. The manufacturer says the adoption of electronic fuel injection reduced consumption and improved performance and ride. With gasoline, the motorcycle can cover 600 km (37 km/l) with a full tank, while a fill-up with E100 covers approximately 450 km (28 km/l).

Although it costs R$ 300.00 more than the gasoline version, the savings from using ethanol are such that, on average, buyers are recovering the extra amount in

approximately two months. Unlike what happened in the 1980s, when both Honda and Yamaha launched ethanol powered motorcycle versions, the new flex motorcycle is not equipped with an auxiliary cold-start system. In the current situation, the manufacturer recommends mixing 2 liters of gasoline with the ethanol on colder days. It is a pioneer product that is expected to open the market for new, similar launches. The technology is not exclusive to Honda.

Traditional auto parts manufacturers, such as Delphi, Magneti Marelli and Bosch, have already developed the technology and are searching for other manufacturers interested in the product. Flex-fuel motorcycles manufactured in Brazil may also be exported to other countries, particularly where transportation on two wheels is popular, like Asia, Africa, Latin America and the Caribbean, representing a complementary manner to add ethanol to gasoline, develop new markets or expand currently existing markets for ethanol.

As one can see, Flex-Fuel technology has advanced considerably in automotive applications. This theme was actually the object of a panel at the 2009 Ethanol Summit, staged by UNICA in June of this year. New applications for this technology, such as civil aviation, are being assessed, and we may well end up having to debate the matter once again in the near future.

Published originally in the July 2009 edition of Opiniões magazine.

Alfred Szwarc is the UNICA´s Emissions and Technology Consultant