Feature Article

Synthetic Biodiesel from Palm Biomass - Can this be a Viable Project?

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Malaysia is a very fortunate nation in which the biomass productivity is very high. Efforts need to be taken to enhance and maximize the use of biomass resources efficiently especially during this time when soaring prices of crude oil has exceeded USD 130 per barrel. There are concerns about world oil production and the increasing demand of liquid fuels especially in the transportation sector. In order to mitigate future shortfalls of crude oil supply. countries all over the world are seeking technologies to produce alternative fuels.

A technology by Alphakat Zukunfts Energie has been developed in Germany and being promoted by Shajeran Resources (M) Sdn Bhd in Malaysia whereby biomass could be converted into ready to be used synthetic diesel. This technology transforms biomass to diesel by catalytic de-polymerization process (CDP), using a special catalyst made of nano-particles at low pressure and low temperature. This patented process (DE 10 2005 056 735) imitates how petroleum is naturally produced. The catalyst cracks the long molecular chains of the hydrocarbons and shortens them in a specific way. This process is called de-polymerization.

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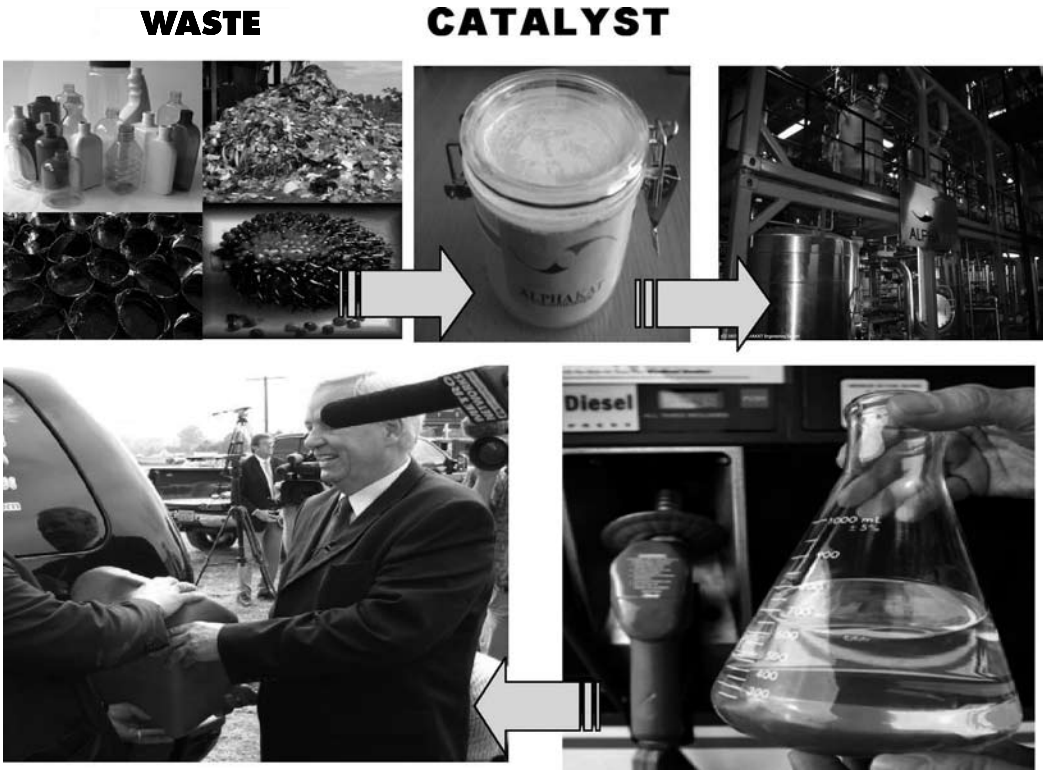
The CDP technology have commercial and test plants in Canada, Mexico, Spain, Bulgaria, Italy, Germany and United States of America converting a wide range of wastes including agricultural residues, municipal solid wastes, electronic wastes, used oil, *etc.* into synthetic diesel.

PROCESS

A new recycling formulation was necessary that would convert existing hydrocarbons not into CH_4 (methane) and C (coke crystals), but into CH_2 and only then in molecule lengths that reduce and bind in a manner that separates unusable pollutants. Solid and inorganic noxious substances cannot contaminate the diesel product, because it consists of vaporized molecules. The oil is circulated without pressurizing through the plant where the hydrocarbon split under the impact of a catalytic converter inside a fluidity rotation unit. The diesel stream is separated in a distillation column and led into a storage tank ready to be used. No dioxin, furan or other toxic products are produced, as the working temperature inside the reactor is only 300°C to 350°C. Chloride ingredients are neutralized in the fluid system. Even when loading input waste materials, the plant is secured against toxins like Prions that are present in organic material, because the process ensures these toxins are bound together.

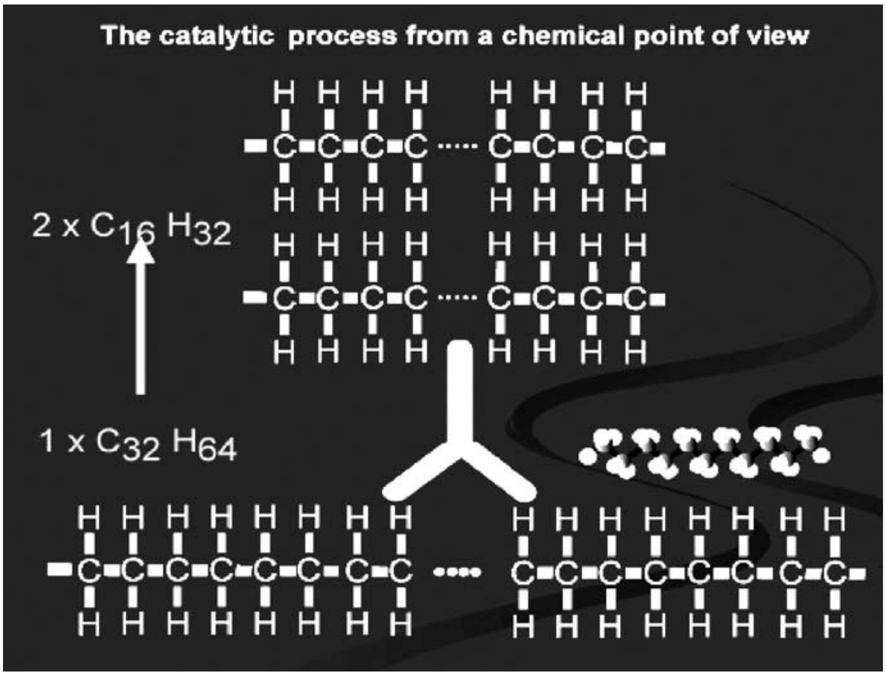


With the CDP procedure, the CH_2-molecule structure remains and the molecule length is only reduced (optimally on C_{15}). Thus, clearly less energy one needs than *e.g.* with pyrolysis procedures, with which first the hydrocarbon chains will smash to CH_4 (methane) and C (carbon). However, for these binding forces to break open large quantities of energy is required. This enormous decrease in consumption at energy causes the clearly higher yield and the superiority of the CDP procedure. With a simple guide, one can measure the yield which can be expected:

CDP diesel has normally a calorific value of 41.8 MJ kg^{-1}.
(1 MJ = 0.27 kW hr^{-1}; a 1 kW hr^{-1} = 3.6 MJ)

Example: Plastic
A plastic X has a calorific value of 35 MJ kg^{-1}.
35 MJ kg^{-1} - 20% (moisture content) = 28 MJ kg^{-1}; 41.8/28 = 1.49;
1.49 t of inputs = 1 t of diesel.
(1 t of diesel = 1160 litres, 1 litre = 0.86 kg)
Result: 650 kg of input = 500 litres hr^{-1}.

The CDP technology uses a catalyst consisting of alkali-doped aluminium silicate. The doping of a fully crystallized Y molecule with sodium was found to be optimal only for plastics, bitumen and waste oils. For biological feedstock such as grease and biological oils, doping with calcium was found to be optimal. For the reaction with biomass, doping with magnesium is necessary to produce high quality diesel oil. For the highly halogenated compounds such as transformer oil and PVC, it is necessary to dope with potassium. Compounds of chlorine in the oil, which could form dioxin or PCBs, are converted into salt and crystallized absorber by the catalyst. Waste containing PVC can be processed un-problematically. Any toxic material left over like heavy metal, chlorine, inert fillers and so on is reliably bound to the catalyst, neutralized for final disposal and extracted with the catalyst. Thus, the diesel is always free of toxic contamination. Impurities and inert fillers, *etc.* which cannot be converted into diesel are bound to the catalyst to be extracted together with it after use.



As the diesel products are in gas form, solid or other inorganic substances contained in the material fed into the reactor cannot contaminate the final product. The moisture produced is transformed into processes water of high purity. The specially developed catalyst of nano-particles is the active agent. Approximately 0.5%-3% of the total amount of material fed into the reactor will be the catalyst. Reaction initiates in used hot oil followed by the synthetic production of diesel from waste in 3 min reaction time in a high speed turbulence system.

The hydrated lime needed for the neutralization of dangerous by-products is to be used only with chloro-fluoro materials, particularly with respect to PVC and PCB oils. Neither the catalyst nor neutralizer are chemically dangerous and can be handled easily, if carefully.

THE END PRODUCT

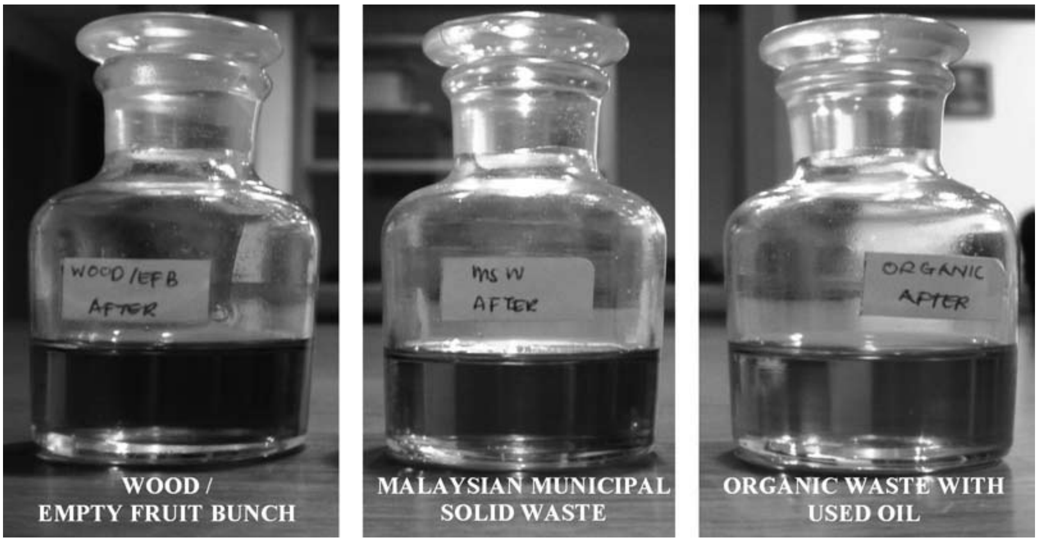
The CDP's final product is a high quality motor vehicle fuel developed exclusively over the vapour phase low sulphur EN 590 diesel fuel and sulphur ppm of between 0 and 50. The finish product is the diesel fuel with a cetane rating more than 56. No blending is needed.

ECONOMIC VIABILITY

Representatives from the Malaysian Ministry of Science, Technology and Innovation visited Alphakat's test plant in Germany on September 2007 with 60 kg of municipal solid waste, biomass (empty fruit bunch and wood residue), medical waste and rubber tyre. The test was a success with all the different Malaysian waste being converted to diesel via CDP technology and was tested on a vehicle for 60 km. Further, a SIRIM test report verifies the authenticity of CDP diesel produced from Malaysian waste.

In addition, Global Energy of United States of America, an initiator of alternative energy projects focusing on the processing of organic solid and many kinds of hydro carbon wastes into usable alternative fuels, reported on a number of tests done on the diesel produced by Alphakat.

The first tests were conducted by the Institute for Neuwertwirtschaft GMBH (IFN) from a feedstock of household waste from the city of Liepzig on approximately 130 litres of synthetic diesel that were produced through the AlphaKat CDP process. The study concluded "this product can be used in CHP's (combined heat and power plants).



For use in the diesel engine area, which is subject to EN590 (The European Standard for diesel for vehicles), sulphur content and stabilization need to be adjusted for full scale industry plants. The refuse contained a maximum of 46% hydro carbons from which the demonstration plant produced diesel from 41%, representing a conversion efficiency of 89%."

ERRSA Energietechnic, a reputable test and regulation institute in Germany from Zitau, separately concluded, based on a test run on a 200 kW diesel engine that the produced diesel had a C.V. of approximately 12 000 Kcal kg^{-1} compared to the EN590 standard of approximately 10 000 Kcal kg^{-1} and a cetane rating of 63.6 compared with the standard EN590. In summary, the tested diesel is special fuel that could provide an alternative to vegetable oil with CPH and to fossil diesel fuel for vehicles. The high calorific value of the diesel would lead to reduction in the diesel engine's fuel consumption and therefore reduction of emissions and logistics costs.