

Meeting the world's need for liquid gold through old tyres

Global economies are dependent on oil to run industries. A dysfunctional supply and demand chain may lead to an energy crisis. Analysts say that escalating oil prices are a prelude to oil shortages. It is for this reason that the industry is seeking ways of deriving oil from varied, even unlikely, ways like tyre pyrolysis, says Angelica Buan in this report.

Fluctuating oil prices in the world market significantly impact daily lives. Amongst the first to sound the alarm is the International Monetary Fund (IMF) that says oil prices will skyrocket to US\$105 a barrel this year. This followed an earlier apocalyptic forecast from the US that by 2015, the world will be short of nearly 10 million barrels/day of oil; and by 2030, the global production of only 100 million barrels/day will be way below the requirement of 118 million barrels/day.

Our oil reserves may never go back to the primeval 2 trillion barrel-level but instead will continue to bottom out. According to a report from the International Energy Agency (IEA), countries like China and the US will require an additional 865,000 barrels/day just to meet their needs.

Anticipating the oil and energy crisis, several oil and gas companies are already charting remote geographic locations to extract oil. The downside to this is getting a pool of skilled workers. Yet other innovations are being considered, for instance, the US shale production for natural gas; using waste to energy methods to derive ethanol and biofuels and organic oil substitutes from used tyres.

Mining oil with tyres

The tyre sector, itself, is a large consumer of oil. According to the US-based Rubber Manufacturers Association (RMA), it takes 7 gallons of oil to produce a tyre; 5 gallons are used as feedstock and the remaining 2 gallons are allotted for the energy supply in the manufacturing process. Imagine the amount of oil that goes to waste when the tyre reaches its end-of-life.

The Rubber Research Institute says that globally some 1 billion end-of-life tyres are generated a year, whilst an estimated 4 billion tyres are heaped in stockpiles, harming the environment.

Recycling old tyres can recover useful end-market resources such as the tyre-derived fuels (TDFs), which are converted into industrial fuels that power cement kilns, paper mills and utility boilers; and the tyre-derived aggregate (TDA). According to RMA, this latter sector occupied a market share of 10% during its heyday in the early 1990s. It currently still shows stability, especially with the demand in civil engineering applications, such as road sub-grades and walls and bridge backfills.

It is no wonder then that tyre manufacturers are seeking recycling methods for old tyres. One of these is tyre pyrolysis, which is claimed to be a safe way to recover scrap tyres for pyrolytic oil (PO) or bio-oil. It can be a substitute for diesel fuel as well as for heavy and light fuel oils for industrial boiler applications. It can also yield carbon black, methane, organic waste, construction materials and fuel briquettes.

Tracing its roots from the 300-year old smelting process of deriving coal and coke, it is a method that heats shredded or whole tyres in an oxygen-free environment. With a specially constructed, oxygen-free reactor vessel, the tyres are heated at high temperatures (reaching as high as 300 to 900 degrees C) to soften the polymer components that eventually become vapours and can be used as alternatives to fuel.

But lately, the process has been making the headlines for the wrong reasons.

Hazardous process

Like any other technology, the capital-intensive process (it requires 60,000 tyres/year) has newer designs that have claimed to be work-safe and zero-pollutant, but some crude mechanisms are operating that do not comply with environmental and health practices.

Early last year, the Philippine Environmental Management Bureau (EMB) of the Natural Resources and Environment (DENR), served closure orders on three tyre pyrolysis plants in Manila, Phil Pao Enterprises, Bio City Scrap, and Ming Hong. The firms produce tyre-derived bunker oils for use in boiler machines of hog raisers. Earlier, another plant belonging to Bio-Eco Solution was also dismantled due to health and safety reasons.

The previous year, 45 such plants in Gujarat, India, were also locked down by the Gujarat Pollution Control Board (GPCB) following complaints of air and odour pollution. The units, found to be using sub-



Tyre pyrolysis is a process used to reprocess the abundant tyre waste into useful material

standard technology imported from China, emitted carbon particles and methane gas.

New policies for pyrolysis required

In the Philippines, the Notre Dame de Vie Insitute (NDV), a local community organisation, has started advocating against sub-standard tyre pyrolysis facilities. According to NDV’s Technical Adviser Flora Santos, pyrolysis operations have been polluting waterways and the environment, especially with the dumping of the char.

Various ailments have also been observed in some 4,000 residents who live near the plants. Santos also said that the plants were emitting chemicals like ethylbenzene, xylenes and toluene, which harm the nervous and respiratory systems, not to mention benzene, dioxans, furans, 1,3 butadiene and polycyclic aromatic hydrocarbons, all potent carcinogens.

NDV spokesperson Arvin Imbong, in an email interview, explained that tyre pyrolysis facilities, within the proximity of the NDV community, were found to be the main culprits of air and water pollution. “It is inevitable that the burning or thermal degradation of scrap tyres will release toxic substances into the air, yet no government rules, programmes or agencies are regulating this,” he said.

The facilities started operating when they were able to secure the Environmental Compliance Certificate from the DENR, a vital permit when starting commercial-scale projects that could impact the environment. But NDV has questioned the granting of such permits, especially since tyre pyrolysis is classified as a non-burn technology.

“Tyre pyrolysis is classified as a non-burn technology”

“In all fairness to the DENR-EMB, the agency with the closest mandate on this matter, they must have been unaware of the proliferation of these facilities that started around 2009. Hence, the NDV, Philippine Nuclear Research Institute, the Industrial Technology Development Institute-Department of Science and Technology (ITDI- DOST), and other stakeholders are presently working with the DENR-EMB’s Air Quality Division to come up with a DENR Department Order that will address this matter. But the process has been slow, so other options are being considered,” Imbong added.

Using safer pyrolysis systems or non-burn technology

Canada-based industrial energy solutions company Klean Industries has viewed the situation in the Philippines and India as a case of an unproven technology gone wrong.

Said the company’s CEO Jesse Klinkhamer, “The proliferation of sub-standard pyrolysis equipment breeds concerns on how safe the process really is. These concerns are understandable. It is very important that the technology has an operational track record and has been built under strict controls where emissions standards meet and exceed those of developed countries.” He also added that there are many features that are part of the process to eliminate pollutants safely.

The 30-year old Klean Industries, which has a capacity of 100,000 tonnes/year, uses a hybrid gasification and pyrolysis process that has been commercially proven in over 50 applications. The process can recover energy, oil and carbon from oil-based waste, such as tyres, plastics and automotive shredder residues.

“Our system is adaptable and customisable for specific applications, likewise, it can be installed anywhere and produce no more emissions than a natural gas boiler,” Klinkhamer claimed.

He went on to say, “We use an environmentally superior technology that efficiently creates electricity and fuels, with a smaller environmental footprint and minimal pollution.”

According to Klinkhamer, tyre pyrolysis is, by principle, a 100% non-burn technology. “You cannot have combustion if you do not have oxygen, it is physically impossible.

Klean Industries’s diesel fuel equivalent



Tyre Industry

However, those unproven technologies, most likely, do not have the ability to operate properly, hence the explosions and or fires (combustion). Again, this brings us back to a proven process whereby proper pyrolysis is 100% non-burn," he averred.

Meanwhile, UK-based Pyreco is able to produce oil from tyres using its ZeroWaste process (PZP). Noel Harasyn, Managing Director of Pyreco said, "Our Eco Oil contains a multifaceted mixture of aliphatic and aromatic hydrocarbons. It is similar in composition to many complex hydrocarbon feed stocks. Many of the more volatile components (toluene and xylenes, for example) could be extracted and used as solvents. Indeed, crude hydrocarbon feedstocks are used as solvents for some polymer systems (such as resins). Styrene, which is a significant component in the pyrolysate, can be used as a monomer to make polystyrene."

Harasyn also affirmed that tyre pyrolysis is a non-burn technology, saying that the notion that it is (a burn technology) stems from confusing it with waste pyrolysis or tyre incineration. "It is important to point out the difference between the two technologies," he said.

"We understand that the plants in the Philippines and India operated outside of the parameters set by local government control, health and safety considerations."

Pyreco's PZP process is compliant to the EU environmental regulations and does not emit gases into air. "Waste heat is used in the carbon pelletising process to ensure a high heat efficiency. Any emissions emanate only from the system's gas burners, but in any case, have to meet the limits prescribed by the UK Environment Agency," he said.

Harasyn went on to say, "There is some waste water produced, predominantly from the steel product cooling quench bath, boiler blow-down and domestic use. The emissions are routed to a sewer and treated."

Reducing tyre waste in the environment

Klean's technology has processed 100,000 tyres and recovered 100,000 tonnes of waste, which translates to the amount of waste produced by 75 million people, according to Klinkhamer. Moreover, the technology is able to produce high grade carbon black substitute that is equivalent to N600 and N700 carbon blacks.

As for Pyreco, Harasyn says that by processing 60,000 tonnes of tyres the firm is able to recover 7,500 tonnes of steel, 20,000 tonnes of carbon black, 20,000 tonnes of gas and 15,000 tonnes of oil (Grade 2).

"Our only limitation on the number of waste tyres it can process is the speed at which it can attract

local investment and operational partners to build additional plants," said Harasyn.

Sustainability is priceless

Harasyn contends that there are still setbacks in the process. "There are more than 3,000 manufacturers of tyre pyrolysis equipment worldwide and each has adopted individual designs and methods of operation. Some reclaim oil, others reclaim gas; while others specialise in steel reclamation. They all reclaim carbon char in varying qualities, mostly as a "throw-away" fuel. As far as tyre pyrolysis is concerned, there are too many standards and no consistency for quality," he said.

Klinkhamer, meanwhile, observes that there are many technologies being implemented, some of which have yet to go through the R&D phase.

Both are of the opinion that commitment to the environment should prevent enterprises to venture into businesses using systems that could damage the environment.

Meanwhile, Klean Industries, which is also an employee-owned organisation assures that its business is firmly attuned to sustainability, even tagging its products as "green".

"Sustainability is about thinking about future generations," Klinkhamer enthused. "Successful companies will be those that capture the tide of increased demand, reduce energy costs and manage their risks better," he said.

A similar sentiment is echoed by Harasyn. "There are those who want to take short cuts to achieve monetary wealth, at the expense of the environment. Pyreco would

like to see a world consortium set up by tyre pyrolysis operators who deliver best practices in the industry," he opined.

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Pyreco reclaims carbon from waste tyres