SYNTHESE DE DOCUMENTS

ANGLAIS
Durée: 3 heures

N.B. : Le candidat attachera la plus grande importance à la clarté, à la précision et à la concision de la rédaction.

RAPPEL DES CONSIGNES

- Utiliser uniquement un stylo noir ou bleu foncé non effaçable pour la rédaction de votre composition; d'autres couleurs, excepté le vert, peuvent être utilisées pour la mise en evidence des résultats.
- Ne pas utiliser de correcteur.
- Ecrire le mot FIN à la fin de votre composition.
- L'usage d'un dictionnaire et de machines (traductrice, calculatrice, etc.) est strictement interdit.

Rédiger en anglais et en 400 mots une synthèse des documents proposés, qui devra obligatoirement comporter un titre.
Vous indiquerez impérativement le nombre total de mots utilisés (titre inclus) et vous aurez soin d'en faciliter la vérification en mettant un trait vertical tous les vingt mots.
Des points de pénalité seront soustraits en cas de non-respect du nombre total de mots utilisés avec une tolérance de +/- 10 %. Concernant la présentation du corpus dans l'introduction, vous n'indiquerez que la source et la date de chaque document. Vous pourrez ensuite, dans le corps de la synthèse, faire référence à ces documents par « doc.1 », « doc. 2 », etc.
L'ordre dans lequel se présentent les documents est aléatoire.

Documents:

- document 1 : a page from www.tyresandmore.com.au
- document 2 : "Old tyres can become a climate-friendly fuel", May 24th 2023, *The Economist*
- document 3 : "Solar-powered fuel cell recycles plastic waste and carbon dioxide", Chen Ly, *New Scientist*, June 2023
- document 4 : "Simple chemistry can recycle polystyrene into more valuable products", Luke Taylor, *New Scientist,* 15 August 2022 -

document 1

At Tyres & More we are conscious of the impact our industry has on the environment and believe it is our responsibility to operate in a way that minimises that effect.

Tyres & More is an accredited voluntary partner of Tyre Stewardship Australia (TSA), the partnership ensures a uniform approach to the environmentally friendly disposal of scrap tyres. The aim is to increase domestic tyre recycling, support new technologies, expand the market for tyre-derived products and reduce the number of end-of-life tyres ending up in landfill or illegal dumps.

Currently Australia produces 56 million end-of-life passenger tyres (EOLT) each year. 72% is re-used, reprocessed or upcycled however still 28% of the volume is disposed of in landfill, buried or stockpiled.

Together with TSA, Tyres & More is committed to reducing the environmental & social harm caused by illegal dumping of end life tyres.

Products made from Recycled Tyres:

New Tyres
Brake Pads
Fuel for Energy Recovery
Athletic Tracks & Sporting Surfaces
Playground Surfaces
Road Surfaces
Marine No-slip Surfaces
Matting Surfaces
Building Installation
Tile Adhesives

document 2

Old tyres can become a climate-friendly fuel
May 24th 2023 – *The Economist*

Getting rid of old tyres has long been a problem. Every year more than a billion reach the end of the road. Until recently, most were thrown into landfills or piled up in storage yards, which occasionally caught fire. Tougher environmental laws mean many countries now insist tyres are recycled. And they are, sort of. Some of the methods might be better than dumping them, but they are not especially green.

Energy recovery is one common method. This involves burning tyres in an incinerator to generate electricity, or as a supplementary fuel to provide heat for cement kilns and other industrial processes. But that produces planet-warming pollution. Tyres can be used whole or shredded in construction projects, such as building embankments or repairing roads. There are, however, concerns about chemicals from the tyres leaching out and contaminating the ground.

Some firms, therefore, have begun exploring an alternative, pleasingly symmetrical idea. Since tyres are mostly made from hydrocarbons, it should be possible in principle to turn old tyres into low-carbon fuel which can be used to run the vehicles they came from.

One of the most ambitious firms pursuing the idea is Wastefront, which is based in Oslo, in Norway. Later this year the company will start building a giant tyre-recycling plant in Sunderland in north-east England. In a couple of years, when the plant is fully operational, it will be able to turn 8m old tyres into new products, including some 25,000 tonnes of a gooey black liquid called tyre derived oil (TDO).

The process works by deconstructing a tyre into its three main components. One is steel, which is used to brace the structure of a tyre and which can be readily recycled. The second is carbon black, a powdery, soot-like form of carbon used to improve the durability of the tyre. The third is rubber. Some of that will be natural rubber obtained from the sap of rubber trees. Some will be the synthetic sort, which is made in factories from crude oil.

In order to do the deconstructing, the tyres are first shredded and the steel bracing removed. The remaining material then goes through a process called pyrolysis. This involves exposing a material to high temperatures in the absence of air. That causes the rubber to decompose into a mix of hydrocarbon gases, which are drawn off. What is left behind is pure carbon black.

Once the drawn-off gas has cooled down, a proportion of it liquefies into TDO. The remaining gases, which include methane, are funnelled back around to be burned, fuelling the reactor. This, says Vianney Valès, Wastefront's boss, creates a closed-loop system that prevents emissions. The overall output of the process by weight is 40% TDO, 30% carbon black, 20% steel and 10% gas.

The carbon black can be re-used to make new tyres. That is of interest to tyremakers because it helps efforts to become carbon neutral. Producing new carbon black requires the partial burning of heavy oil residues or coal, which produces plenty of greenhouse-gas emissions.

The recovered TDO is similar to crude oil fresh from the ground, and is well-suited for making diesel. To do that, Wastefront is working with Vitol, a Swiss company that is the world's largest independent oil trader, and which operates a number of refineries around the world.

While not completely carbon-neutral, diesel made from TDO does produce an 80-90% reduction in emissions of carbon dioxide, the main greenhouse gas, compared with the conventional fuel. The future market for cleaner fuels is likely to remain substantial, even though electric vehicles are steadily replacing those with combustion engines. Fossil-fuelled vehicles will remain on the road for decades to come, particularly large commercial vehicles like lorries, which are harder to electrify and which are big burners of diesel. The fuel will also be needed by trains and ships. So, anything that helps to clean up overall emissions during what will be a long transition to the electrification of transport is useful—especially if it also shrinks a mountainous waste problem.

document 3

Solar-powered fuel cell recycles plastic waste and carbon dioxide

By combining a solar fuel cell that converts carbon dioxide into fuel with a plastic recycling system, researchers can create sustainable fuels and useful chemicals

By Chen Ly - 19 June 2023 – *New Scientist*

A solar-powered device could help remove carbon dioxide from the air and convert plastic waste into sustainable fuel and useful chemicals, in a double-whammy of recycling.

Previous research on solar fuel cells, a technology that uses sunlight to drive chemical reactions that produce fuels, have used pure CO2. Now, Erwin Reisner at the University of Cambridge and his colleagues have developed a device that utilises CO2 captured from industrial processes or directly from the air, filtering out other gases as needed.

“There has been a tremendous advance in developing carbon capture and sequestration technologies. In parallel, there’s been a lot of development in solar fuels devices,” says Reisner. “This is the first time combining the two.”

The device is split into two compartments. One filters air through an alkaline solution that catches CO2, then converts it into syngas, a fuel that is usually used to make ammonia or methanol. In the other, a solution derived from PET plastic waste gets converted into glycolic acid, a chemical that is commonly used in cosmetics.

Combining these two compartments isn’t just a case of creating a two-in-one gadget because the pair actually work together. For CO2 to transform into syngas, it needs to gain some electrons. Typically, this is done by breaking up water molecules, but that process is energy-intensive, says Reisner. Instead, the two compartments act like a battery, with the CO2 side the cathode and the plastic side the anode, transferring electrons between them.

As a proof-of-concept prototype, the technology still has a long way to go before it can be deployed at a large scale. “One of the things we are trying to improve is the efficiency,” says team member Sayan Kar, also at the University of Cambridge.

In the future, the researchers hope that the technology will help eradicate new fossils fuels from the economy entirely. “The process is completely circular,” says Reisner. “We capture CO2. We make a fuel. You use it. You form the CO2 again.”

Reisner also notes that this demonstrates there is an alternative to just capturing CO2 and storing it in places like underground reservoirs. “You pump it somewhere, but we don’t know the long-term consequences. Now, we show you can actually make useful products from it.”

“It is a nice chemistry, but it’s difficult to say if it would compete with existing processes,” says Jotheeswari Kothandaraman at Pacific Northwest National Laboratory in Washington state. “Techno-economic and life cycle assessments are needed to know the economic feasibility and carbon footprint of the approach.”

document 4

Simple chemistry can recycle polystyrene into more valuable products
UV light plus aluminium chloride as a catalyst can break down polystyrene so that it can be turned into a chemical used in fragrances and medicines

15 August 2022 - Luke Taylor – *New Scientist*

Researchers have found a way to upcycle plastic waste into more valuable products, which they say could help tackle the growing accumulation of non-degradable waste polluting our cities and threatening life in our oceans.

Guoliang Liu at Virginia Tech and his colleagues have developed a method to break down polystyrene and convert it into a chemical that is far more valuable. The process is energy efficient and adaptable to other plastics, the researchers say.

Less than 10 per cent of the world's polystyrene is currently recycled and many countries don't recycle it at all because there is no economic incentive, says Liu. Polystyrene waste is expensive to transport and costly to break down, and recycling it only creates more polystyrene, which has little value.

Discarded protective packaging and takeaway food containers made from polystyrene don't break down naturally. They often make their way into the sea through rivers or are sometimes burned, releasing toxic chemicals.

Liu and his colleagues used ultraviolet light as an energy source and aluminium chloride as a catalyst to break down the chemical structure of the polystyrene. They then used the same catalyst and added dichloromethane, a clear liquid commonly used as a solvent, to generate diphenylmethane.

Diphenylmethane is a chemical commonly used in fragrances and medicines. It is 10 times more valuable than polystyrene itself, so the conversion creates an economic incentive to reduce polystyrene waste.

The reaction takes place at ambient temperature and at atmospheric pressure, so it requires less energy than existing methods of recycling or upcycling polystyrene. The process is easy to adopt and could be profitable at a large scale, according to the team's economic analysis.

"The most interesting thing is this is standard chemistry," says Liu. "We're not using really strict conditions, an expensive catalyst or fancy reactions. All the components that we use for this process are pretty readily available."

Liu's team is developing a catalogue of other valuable chemicals that could be obtained by changing the chemical reaction used in the final step of the upcycling process.

The concept also applies to almost all other plastics, so could help turn one of the largest environmental threats into a sustainable circular economy, says Liu.

Although the process is more cost efficient than existing recycling methods, the drawback is that it could take more time as it is scaled up, says Bushra Al-Duri at the University of Birmingham in the UK. The process also uses some environmentally unfriendly solvents, which could prevent it being carried out at an industrial scale.