Simple chemistry can recycle polystyrene into more valuable products

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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

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.

Source : New Scientist