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From Waste to Wealth using Green Chemistry

Increasing demand for consumer goods from an increasing world population is placing enormous strain on the resources needed by the worlds manufacturing industries. Traditional resources have often been from non-renewable sources located in relatively accessible regions but these are finite, their exploitation non-sustainable and they are becoming scarce. At the same time, the wastes generated in manufacturing and in use of the articles of todays society have been allowed to accumulate in landfill sites which are now filling up in many developed countries leading to the questionable export of large quantities of hazardous substances across the planet. This "out-of-sight, out-of-mind" reaction to the problem can create serious health and safety problems in regions where wastes are allowed to accumulate or are being processed without adequate protection for the local population.

We need a closed loop approach to the twin problems of resource and waste by making the latter the solution to the former – waste is the future resource. To fully exploit the concept and make it widely useful to both inter- and intra-sector industry transfer while maintaining environmental advantage, we need to use Green Chemistry and especially Green Chemical Technologies to extend the value of waste streams. Food supply chain wastes ("from farm to fork") are especially useful as sources of organic chemicals for a variety of processes and products but it is important that these meet certain critical criteria including their large scale availability preferably in several locations worldwide. Examples include the physical modification of polysaccharide wastes for use as novel Starbon® materials for applications including the separation of natural products and water purification; the use of chemically modified polysaccharide wastes as switchable and flame resistant adhesives, the use of limonene from citrus peel as a solvent and catalyst pre-cursor, and the use of the ashes from burning biomass as a source of silicate binders and porous silicate materials. The current concerns over the availability of critical elements may also be partly relieved by realising the potential of large volume wastes from mining and power stations.

New, energy efficient conversion and extraction technologies that can convert a wide variety of waste streams into valuable chemicals include low-temperature microwave processing and benign solvent extractive fractionation, as well as downstream processing of bio-extracts and the production of new bio-based chemicals will be described in several case studies.

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