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Pharmaceutical Services

DESIGN FOR SUSTAINABILITY – THE CONSIDERATIONS BROUGHT TO LIFE

In this article, Oli Gould, Sustainability Solutions Lead at Owen Mumford, explores the use of lifecycle assessment in product design for sustainability to impact the environment positively.

Designing more sustainable drug delivery devices is a complex process. Lifecycle assessment (LCA) is an essential methodology to evaluate the environmental impact of drug delivery devices throughout their entire lifecycle. This helps to identify areas for improvement and informs design decisions to minimise environmental footprint. According to ISO 14040, an LCA addresses the environmental aspects throughout a product's lifecycle, as well as the potential impacts on the environment, from raw material acquisition, throughout production, use, end-of-life treatment, recycling and final disposal.[1]

Owen Mumford has developed a lifecycle-based eco-design tool in collaboration with a world-leading LCA consultancy, enabling the company to autonomously model the environmental impact of new product concepts, from raw material extraction to disposal. Owen Mumford builds various scenarios in the tool to assess different product concepts and configurations, including material choices, component weights, packaging and efficiency, transportation, material supply and manufacturing location, and various end-of-life scenarios. Importantly, the tool is designed to be easily used by personnel who are not LCA experts, so that they can compare the environmental impacts of different scenarios. The tool also allows for easy communication of the results within the company to drive collaborative and science-based decision making.

The key reason for such cross-department collaborations is that they enable eco-design to be included in early decision making – comparing several scenarios at the same time. Scenario comparison is critical because of the interaction and influence between different aspects of sustainability. Improving one aspect may well degrade another. Often, it is not crystal clear where the highest impacts come from, especially when considering global supply chains. Is it better to reuse medical devices and give them a more robust design? Or does the increased transportation weight outweigh the environmental benefits?

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LIFECYCLE CONSIDERATIONS BROUGHT TO LIFE

Much is written about the principles of LCA in building more sustainable product lines. However, the subject is brought more to life – for non-expert industry players and for healthcare professionals – if broken down into some of the typical real-life considerations encountered in new product development. A selection of those typical considerations is discussed below.

Disruptive Thinking

How is the drug supplied? Flexing the delivery device brief around the state of the drug product can bring wider sustainability benefits. For instance, can the drug be lyophilised (freeze-dried) and

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then recombined through the device at the point of administration? The benefits of such an approach could be considerable – such as the sustainability gains in cold chain, drug development timelines, drug manufacturing and drug shelf life.

Efficient Design

During the process of developing devices, designers can conceptually design them to use the greenhouse gas budget efficiently by selecting materials and geometry that achieve the optimal combination of:

- Emission factor per unit mass
- Strength and stiffness per unit mass
- Manufacturing-related mass constraints
- Mass-and-process-related manufacturing emissions
- Downstream size and mass-related impacts, such as packaging, distribution and end of life.

Design for Circularity

Similarly, circularity can be incorporated into the design process from the very start, not as an after-thought. How can the materials used be cycled at their highest value (i.e. reused in the same or similar applications)? How can the product be designed for longevity without affecting the product footprint? This requires striking a balance between manufacturing footprint and the usable lifetime required (they can often pull against one another).

Design for Refurbishment, Remanufacture, Disassembly or Recovery

The complex analysis of overall sustainability may preclude highest value cycling. In which case, in what ways can the product either be cycled at the "next best" point of value (as components and/or assemblies) or at the "least best" point of value (as raw material)?

Original Materials

Can manufacturers use recycled materials at the point of manufacture? A key design consideration is the incorporation of recycled materials into new devices from within and outside the production environment.

Use of Renewable Energy at Suppliers

Renewable energy should, by its definition, be circular. However, when choosing a supplier, it is important to not only consider whether that supplier reports using renewable energy but also the financial mechanism through which that renewable energy is obtained. Will a purchase with that supplier yield further investment in renewable energy generation? On-site renewable energy generation and direct power purchase agreements (PPAs) may be considered more robustly "100% renewable", while sleeved or virtual PPAs, supported by renewable energy certificates, for example, are less robust.

Renewable Raw Materials

According to industry estimates, bioplastics make up less than 3% of the medical polymers used in medical devices and under 1% of the market for medical polymers as a whole.[2] Clearly, a wholesale move to bioplastics would have a major effect on sustainable product design. However, some data suggest that renewable feedstocks for polymers may offer little or no benefit to key measures such as global warming potential over fossil-based feedstocks. Great care needs to be taken when reviewing biomaterial footprints to ensure that study boundaries and allocation of sequestered carbon (CO_2 absorbed by the feedstock material) are appropriate.

Reduce the Use of Finite Resources

This is different from substituting more sustainable raw materials (although it does involve using recycled feedstock). As an intrinsic design consideration, this means minimising the amount of abiotic resources (fuel, light, water, substances, chemicals, etc) to manufacture, transport, deploy and employ, recover and recycle/dispose of the product throughout the supply chain.

KEY TAKEAWAYS

The medical device industry is working hard to establish greater circularity and sustainability in its products and their use in the real world, from conception to disposal. Yet we must continue to communicate just how subtle and complex the assessment for lifecycle footprint is, and how some seemingly obvious decisions over sustainability may have negative consequences in the supply chain – whether regarding transport, storage, waste, contamination risk or a host of other possibilities. Equally, assessment techniques must conform to universally recognised standards, using definitions that truly reflect a net positive impact on the environment. That way, the whole of the industry and the end users in healthcare will more easily understand the subtlety of sustainable design, and what "good" looks like at each phase of the process.

ABOUT THE COMPANY

Owen Mumford is a major healthcare company and device manufacturer that commercialises pioneering medical products in its own brand and custom device solutions for the world's major pharmaceutical and diagnostic companies. Owen Mumford's goal is to enhance access to diagnostics, encourage adherence to treatment and reduce healthcare costs, making a world of difference to a world of people.

REFERENCES

1. *ISO 14040:2006 Environmental management Life cycle assessment Principles and framework. ISO, 202. Accessed Apr 2024.*
2. *Mankar U, "An introduction to bioplastics in medical applications". Medical Plastics News, Jan 13, 2023.*

"A key design consideration is the incorporation of recycled materials into new devices from within and outside the production environment."

ABOUT THE AUTHOR

Oli Gould is an experienced Design Manager with a background in engineering and 10 years' experience working in medical device development, preceded by several years working with household consumer technology brands. As R&D Sustainable Solutions Lead at Owen Mumford, Mr Gould supports the development of innovative new medical devices. Alongside a range of competences, he specialises in engineering analysis and environmental sustainability in product development.

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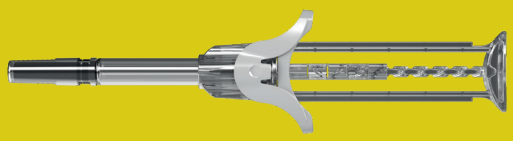

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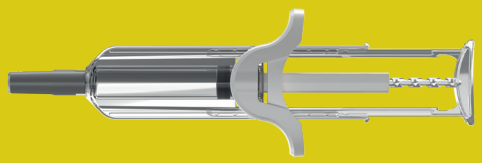

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