Circularity with Adhesives and Sealants

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Present day, many corporations consider the importance of transitioning to a circular economy. The trade association for the adhesive and sealant industry, Vereniging Lijmen en Kitten, wants to give relevant actors a broader perspective when it comes to circular products with adhesives and sealants. One way to achieve this, is by examining this issue from a product design perspective. This generated the following main research question:

"How can one create guidelines for product designers that will guide them to use adhesives and sealants in a product to bond several parts, while not inhibiting the circularity of these parts?"

In order to answer this question, research has been conducted on multiple topics:

- The circular economy and circular product design.
- The functions and applications of adhesives and sealants.
- The perspective of product designers on circular products with adhesives and sealants.
- Design techniques that are relevant to design circular products with adhesives and sealants.
- The characteristics of the target group and requirements of such guidelines.

This research has been completed by examining literature, conducting interviews and distributing a survey. This provided enough information to develop a design guide that product designers can use to make products with adhesives and sealant more circular.

Out of the research came that it is hard to make products completely circular, so the aim of the design guide is to make products more circular. Furthermore, the survey confirmed that product designers are generally engaged in designing for circular products. However, a majority views adhesives and sealants as hard to separate from product parts, making it harder to reuse parts of the product. However, they do mention that this can be solved by the development of the right design techniques.

Design for disassembly is one of the aspects to take into account when developing a circular product. In order to remake the parts of a product or to recycle the materials, the product needs to be disassembled. In the research, it also came forward that the main function of adhesives and sealants is to join two parts together. This resulted in the decision to implement design techniques into the design guide that are guidelines to design for disassembly.

After acquiring enough information about this topic, the design guide has been developed. The design guide focuses on design for disassembly and is divided into five categories: connections, product architecture, access, disassembly sequence and modularity. Each of these categories contains multiple design techniques on that specific topic. Furthermore, each design technique is explained more thoroughly by including a visualized example.

To test the developed design guide, it has been used in a case study. This case study contains the redesign of a barstool. By implementing design techniques from the design guid into the redesign process, the product became more circular. This case study also provided points of improvement for the design guide, which have been implemented afterwards. In Figure 1, an impression of the final design guide is presented.

Figure 1. The cover of the design guide.

Thereafter, the conclusion and discussion resulted in a few recommendations for further research:

- Design for future proof and design for maintenance will make the product even more circular.
- The material flow is important to consider in order to make the product entirely circular.
- Multiple case studies can be done to improve the design guide further.