CRADLE TO CRADLE® DESIGN INNOVATIONS

Marko Krajner, Stanislav Pracek

This Publication has to be referred as: Krajner, M[arko] & Pracek, S[tanislav] (2019). Cradle to Cradle® Design Innovations, Proceedings of the 30th DAAAM International Symposium, pp.0311-0317, B. Katalinic (Ed.), Published by DAAAM International, ISBN 978-3-902734-22-8, ISSN 1726-9679, Vienna, Austria
DOI: 10.2507/30th.daaam.proceedings.041

Abstract

The Cradle to Cradle® concept defines and develops the reuse of products. Compared to traditional recycling, it maintains the same level of quality of raw materials through the life cycles of several products, and only safe chemicals are used. Products are developed in accordance with the principle of maintaining the quality of raw materials over several life cycles, even if we take into account the use, production processes and reuse. This means: no waste, since all ingredients are treated as nutrients for the next cycle. The right materials are included in certain cycles (metabolism) at the right time and in the right place. The approach of a circular economy analyzes the recycling economy in the value chain, which leads to the generation of revenue from recycled materials. Cradle to Cradle® defines quality preservation as well as the cost-effectiveness of the value-added chain. Re-use materials from Cradle to Cradle® products allow the cost of materials to be as close as possible to the cost of materials. Even if additional costs arise due to processing or cleaning, they are still lower than the market price of the material. The Cradle to Cradle® model transposes the principle "quality is equal to quantity" to industrial systems. The flow of materials is designed to be useful and useful for the restoration and conservation of biological and technical resources. This approach stems from the tendency to slow down and reduce the negative impacts on the environment. Breakthrough projects and innovations of Woford, Bayonix, DyStar, Clariant and Calida will be presented.

Keywords: Cradle To Cradle; Sustainable Development; Innovations; Certification

1. Introduction

The fashion industry is the second largest polluter in the world, behind oil. It's time for change. It's time to break the habit together. The Cradle to Cradle® concept defines and develops the reuse of products. For a world that goes beyond the next generations with consumer-safe products from a biological or technical point of view. How industry need to react towards more safer products is huge question, but Circular Economy is demand. Cradle to Cradle Design opens the perspective of an industrial society where processes of production and use are designed by transfer of principles of Nature [1], [2]. Nature knows material flows, but Nature does not know waste, avoidance, constriction and restriction. Nature is simply involving right materials at the right place and at the right time. Cradle to Cradle designed products and certification scheme behind overview and confirm Circular Economy concept with safe chemicals. In the case of textiles treated with chemicals innovation is needed to develop only chemicals which are safe for biological cycles [3], [4], [5], [6].

1.1. Cradle to Cradle® Design defines and develops cycle able products

The Idea - Cradle to Cradle® Design defines and develops cycleable products. In regard to differentiation to conventional recycling the quality level of the raw materials remains throughout multiple product lifecycles and only purely “assessed safe chemicals” are used.

The products are developed according the model to maintain the quality of raw materials over multiple life cycles taking the production processes, the use and the reutilization into account. This means: No waste, all ingredients are considered as nutrients. The right materials are integrated in defined cycles (metabolism) at the right time and place.

The 3 Cradle to Cradle® Design Principles:

- Waste = Food
- Energy: use of renewable resources
- Diversity

Nature as a model reflects ongoing developments in a Cradle to Cradle® product: Flourishing trees in spring are only apparently redundant. From a few blossoms new trees are growing. All blossoms not used for growth, fall to the ground and become nutrients.

Cradle to Cradle® Products reach a new quality dimension and distinguish themselves through high economic value as well as modest, ideally with no environmental damage. They achieve high consumer friendliness and are credentials of a paradigm change towards consumer behavior and in the industrial production.

Cradle to Cradle® Design defines not only form, functionality and ingredients of a product. The goal is to strive for a new dimension in quality and safety in endless cycles.

New innovations need to be developed for safer products for people and nature. Industrial composting is one possible solution, how biologicaly designed products could become soil at the end of Life-cycle.

Fig. 1. Biological cycle

Consumer Goods (natural fibers, cosmetics, detergents, etc.) are designed so that they can be used in biological cycles over and over again. They decompose to organic nutrients and promote biological nutrients and systems such as plant growth. The renewable raw materials are in turn the basis for new products.

Fig. 2. Technical cycle

Service Products (TV sets, cars, synthetic fibers, etc.), the so-called technical nutrients, are separated to enable the production of new commodities after fulfilling their initial function. The users / consumers purchase only the relevant services, e.g. Television. The materials remain the property of the manufacturer, which retains them through collection and reenters them into the technical cycle.

New business models need to be developed for services in technical cycle.

1.2. Differentiation: Quality equal Quantity

Cradle to Cradle[®] Design transmits the principle “Quality equal Quantity” to industrial systems. Materials together with material flows are designed to be beneficial and useful for the regeneration and conservation of biological and technical resources. This approach liberates from the present obligation to diminish, reduce or slow down the need to negative environmental impacts. This is new paradigm in industrial systems.

2. EPEA Switzerland GmbH

EPEA Switzerland GmbH supports companies in different areas of activities in the development and implementation of Cradle to Cradle[®] design concepts.

With an experienced, internationally oriented and interdisciplinary working management team, Cradle to Cradle[®] projects are implemented in all industries in the Alpine region (mainly Switzerland and Austria) and in the textile industry worldwide. Scientific reviews for all projects are created in close cooperation with EPEA Internationale Umweltforschung GmbH- Part of Dress&Sommer.

Fig. 3. EPEA Switzerland is an accredited general assessor for the Cradle to Cradle CertificationTM[7].

3. BREAKTHROUGH INNOVATIONS in TEXTILE INDUSTRY

3.1 Wölford

Austrian textile company Wölford is located in Bregenz in Austria and in Murska Sobota in Slovenia. It's opening a new story in direction of circular economy. That's breakthrough on textile and clothing area. After five years of team working in cooperation of 15 companies they made it to certify a biological cycle decomposition over industrial composting as technical cycle through the decomposition of textiles. Both certification are in performance on GOLD Level Cradle to Cradle CertifiedTM and appearance is luxurious. Breakthrough innovation in textile industry worldwide.

Fig. 4. Certification line of premium textile Wölford

3.2 Bayonix

In biological system bottle Bayonix is one of larger systemic solutions against plastic pollution. 89 billion liters of water are put into bottles each year. Only in Germany every second 1500 bottles are consumed. About 80% of these bottles ends up in the trash. In Germany is in circle about 800 million such bottles, so about 500-600 million bottles are returned back every year. Around 35 billion plastic bottles are collected annually in landfills and in our oceans.

Bottled water cause 90 to 1000 times more environmental pollution than water supply.

For production of plastic bottles for one use, is required about 3 litres of water to produce each bottle. Between Hawaii and American coast is island large as Central Europe, build from discarded plastic waste. It is estimated to weight over 3 million tonnes. Scientists have calculated that there is six time more plastic than plankton in the see. When broken down in to microplastic, they can also enter into our food chain.

Disposable plastic bottle takes about 450 years to break down naturally. Raw materials are decreasing and the quality of recycling are getting worse. We used environment 1,6 times more intensely than nature can regenerate on its own.

The dangers are solvents and plasticizers such as phthalates, antimony, bisphenol and many more. In the year 2009 scientists from Frankfurth found that commercial bottles filled with mineral water and bought in German supermarkets contain hormone active contaminants. Hormonal pollutants can damage hormonal system. That can lead to serious helth problems such us imunne deficiencies and reproduction. They are in risk like small childrens and fruits with even the smallest injuries likely to couse subsequent damage.

Bayonix is the first sports bottle to recive Cradle to Cradle certificate at the gold level. Very light bottle in which is the liqid is 100% free of harmfull substances! The first sports bottle is also 100% biodegradable and recycled.

Fig. 5. BAYONIX bottle

3.3 DyStar

The DyStar Group is a leading dyestuff & chemical manufacturer and solution provider, offering customers across the globe a broad portfolio of colorants, specialty chemicals, and services. With a heritage of more than a century in product development and innovation for the textile industry, DyStar also caters to multiple sectors including the paints, coatings, paper and packaging industries. Its expansion into the food & beverages and personal care sectors reinforces the company's position as a specialty chemical manufacturer. DyStar's global presence offers customers reliable access to experts from offices, competence centers, agencies and production plants spanning over 50 countries.

The assessed Dystar Textile Dyes have achieved a Material Health Certificate on the Gold level. They include VAT Dyes, Reactive Dyes, Disperse Dyes, Indigo Dyes and a Reactive Dye for wool. The DyStar Group has offices, competence centers, agencies and production plants in over 50 countries to ensure the availability of expertise in all important markets.

With a heritage of more than a century of product development and innovation for the textile and leather industry, DyStar has developed into new markets and now in addition serves the paper, plastic and many other specialty chemical industries.

Approved for use: dyes are available and the collection is displayed in the table 1.

#	VAT Dyes	Reactive Dyes	Disperse Dyes	Reactive Dye for wool
1	Indanthren® Brilliant Orange GR Coll	Levafix® Amber CA-N	Dianix® Blue XF	Realan Black MF-PV
2	Indanthren® Red FBB Coll	Levafix® Brilliant Yellow CA	Dianix® Yellow AM-SLR 200%	
3	Indanthren® Brilliant Green FFB Coll	Levafix® ECO Forest	Dianix® Yellow S-3G	
4	Indanthren® Olive Green B Coll	Levafix® ECO Black	Dianix® Yellow Brown XF2	
5	Indanthren® Scarlet GG Coll	Levafix® Fast Red CA	Dianix® Yellow XF2	
6		Remazol® Brilliant Blue RN	Dianix® Orange AM-SLR	
7		Remazol® Brilliant Red F3B	Dianix® Turquoise S-BG	
8		Remazol® Brilliant Yellow GL 150%	Dianix® Blue S-BG	
9		Remazol® Yellow GR 133%	Dianix® Brilliant Violet R	
10		Remazol® Luminous Yellow FL 150%	Dianix® Red AM-SLR	
11		Remazol® Golden Yellow RGB	Dianix® Red XF2	
12		Remazol® MAP Black NN	Dianix® Rubin XF2	
13		Remazol® Navy RGB 150 %	Dianix® ECO Black HF	
14		Remazol® Red RGB		
15		Remazol® Ultra Carmine RGB		
16		Remazol® Ultra Orange RGB		
17		Remazol® Ultra Orange RGBN		
18		Remazol® Ultra Rubine RGB		
19		Remazol® Ultra Navy Blue RGB		

Table.1.Available dyes(as example)

3.4 Werner&Mertz

Company Werner & Mertz indenpendently developed raw material and system evaluation. Now they work on the next step who studies system in opozite with objective criteria. Measure for that is idea Cradle to Cradle® project promoted by agency for enviromental protection (EPEA Switzerland) – An internatioanal research and environmental advisory institution based in Switzerland. The perspective argues that Cradle to Cradle® is in direct contravention of the EPEA principles of linear production known as “Cradle to Grave”. In this concept material flows are formed without conscius consideration of the protection of natural resources.

Cradle to Cradle® is based on biological and tehcnical cycles, not on product design. The challenge is to plan product progress throught the whole material cycle. Product materials must be appropriate for a complete and safe return in biosfere or for recovery and quality reuse. Key meaning in process plans is design of holistic connotation of quality throught pozitive indentification iof ingredients. Products must be designed in the future to be useful for material cycles. It is necessary to improve the quality of recycled fractions so that recycling is possible at the same or even higher level.

Ingredients with pigments and additives should be selected in such a way as to prevent toxic effects during use and in other stages such as production, recycling and reuse. For example raw oils, once used as a raw material for plastics, stays in circle and is not irreversibly burned. The energy needed for recycling and all other production processes must be prepared from renewable sources and in an environmentally more friendly way. Good example of this is production of a new PET packaging bottle made from old PET bottles.

Fig. 6. Certified product WERNER&MERTZ Frosch GOLD

3.5 Clariant

As one of the world's leading specialty chemical companies, Clariant contributes to value creation with innovative and sustainable solutions for customers from many industries. Our portfolio is designed to meet very specific needs with as much precision as possible. At the same time, research and development is focused on addressing the key trends of our time. These include energy efficiency, renewable raw materials, emission-free mobility, and conserving finite resources. Business units are organized into four business areas: Care Chemicals, Natural Resources, Catalysis and Plastics & Coatings.

New innovation project from Clariant is called FROM RICE GRAIN TO LICOCARE® RBW Cradle to Cradle Certified. Multi-purpose additives are derived from crude rice bran wax. This is a by-product from the production of rice bran oil. Clariant chemically and physically upgrades this renewable raw material and thus contributes to using the rice grain's full value. This will have huge impact on plastic industry worldwide, and is designed according to Cradle to Cradle principles.

Fig. 7. Clariant LICOCARE ® RBW

3.6 Calida

CALIDA looked to nature for inspiration when it designed its "I love nature" collection.

At CALIDA have more than 75 years of experience designing and manufacturing underwear – and they want to get even better. Their aim is to offer underwear suitable for every day, every taste and every situation. And top priority is always durability, quality and attention to detail – from design and fit, developing the best materials, through to the workmanship of the final product.

With the I LOVE NATURE range, CALIDA has created a true innovation in the field of sustainability; the compostable range made from TENCEL®MICRO fibers, Natural, eco-friendly and functional. Soft against the skin, temperature-regulating, fast-drying and odour-minimising.

Fig. 8. Calida "I love nature"

4. Conclusion

The Cradle to Cradle® concept improves the economy in the entire value cycle of a product. Industry need to step into Circular Economy, which is still relative unknown territory. Related risks within the supply chain and the production achieve higher transparency. Circular Economy approach solve raw materials use in multiple cycles. The cost of the economy, the environment and the social aspects become predictable and profitable. All substances and materials along the entire supply chain are being considered from raw materials to products within the Cradle to Cradle® Design Concept. Solutions are seen with presented projects, products, which are feasible, and already on the market. This results in a product of unmatched quality. Cradle to Cradle® Design through Biological cycle use industrial composting or biodegradation as solution, through Technical cycle reuse in industry. Therefore, a continuous raw material use is practice without restrictions. EU adopt ambitious plans how industry needs to react, and Cradle to Cradle® is right way for industry to achieve this goals.

5. References

- [1] McDonough, W., Braungart, M. (2002), Cradle to Cradle, Remaking the way we make things, New York, North Point Press.
- [2] Kunič, R. (2017), Carbon footprint of thermal insulation materials in building envelopes, Energy Efficiency. Springer, <https://doi.org/10.1007/s12053-017-9536-1>
- [3] Kunič, Roman. Vacuum insulation panels - an assessment of the impact of accelerated ageing on service life. Strojniški vestnik, ISSN 0039-2480, okt. 2012, vol. 58, no. 10, str. 598-606, SI 121, ilustr., doi: 10.5545/sv-jme.2012.539
- [4] Cradle to Cradle Certified™ Trademark and Cradle to Cradle® C2C® Copyright (2017), Registered trademarks of McDonough Braungart Design Chemistry (MBDC). Cradle to Cradle Certified™ is a certification mark licensed exclusively by the Cradle to Cradle Products Innovation Institute (C2CPII), all rights reserved. www.c2ccertified.org. Accessed 15 November 2017.
- [5] Praček, S. (2010). Theoretical model of unwinding process from packages, Annals of DAAAM for 2010 & Proceedings of the 21 st International DAAAM Symposium, 20-23rd October 2010, Zadar, Croatia, ISSN 1726-9679, ISBN 978-3-901509-73-5, Katalinic, B. (Ed), pp. 1469-1470, Published by DAAAM International Vienna, Vienna
- [6] Praček, S. (2010). High-speed yarn transport systems simulation, Annals of DAAAM for 2010 & Proceedings of the 21 st International DAAAM Symposium, 20-23rd October 2010, Zadar, Croatia, ISSN 1726-9679, ISBN 978-3-901509-73-5, Katalinic, B. (Ed), pp. 1471-1472, Published by DAAAM International Vienna, Vienna
- [7] Braungart, M. (1992), An Intelligent Product System to Replace Waste Management Braungart, Engelfried Fresenius Envir Bull 1:613-619 Birkhauser Verlag Basel Switzerland 1018-4619/92/090613-07 S 1.50-0.20/0.