<table>
<thead>
<tr>
<th>Name</th>
<th>Fibertype</th>
<th>Process</th>
<th>Pro's</th>
<th>Con's</th>
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| **Standard mechanical recycling (Fibre Recycling)** | Natural fibres (Cotton fabrics)               | • Mechanical tearing of fibres, unravelling, grinding, defibrating and cutting  
• Developed process (e.g. SOEX with H&M)  
• Currently less than 0.1% of recycled amounts textiles is recycled into yarn and new textiles | • Reduction in use of new fibres  
• Substitution of raw material production (cotton farming) | • Max 30% recycled fibres  
• Reduction of Fibre quality → Downcycling  
• Ecologically questionable |
| **Standard chemical recycling**           | Synthetic fibres (synthetic polyester as mostly used fibre) | • Textile materials are roughly cut up and decomposed into individual monomers by the addition of various chemicals → Feedstock to produce monomers of virgin quality  
• Developed process (e.g. Teijin, Parley for the Ocean)  
• Concerning natural fibres neither technologically nor economically mature | • Recycling without affecting quality  
• Same price as conventional fibres | • In currently developed processes restricted to single-origin articles  
• High energy consumption  
• High capital investment |
| **Chemical Recycling: ECO CIRCLE™ FIBERS by Teijin** | In principle, recycling of a mixed-fibre product is feasible but the end-product is restricted to mono-fibre articles like functional sports shirts from polyester  
⇒ most recycled fibres are not made from post-consumer garments but from other sources of used plastics, such as PET bottles | • Recycling of polyester from used-clothing, PET bottles & production waste PET  
1. Material is cut and washed  
2. Compounding / Solving in ethylene glycol  
3. Reaction with methanol | • Commercially available process  
• Similar quality as oil-based virgin materials  
• Reduction in energy consumption by 84% | • System does not accept all polyester products  
• 10 to 20% more expensive than using virgin materials  
• No closed loop recycling as input is mostly no textile waste |
| **Fabric recycling of Pre-Consumer-Waste** | Natural and synthetic fibres                  | • Re-manufacturing: Pieces of complete fabric mostly from factory offcuts and leftover materials are re-sewed to create new garment  
• Developed process not requiring advanced technologies  
• Networking of companies in order to coordinate supply and demand of "preconsumer-waste" | • Environmental-friendly  
• 20-90% share of recycling content is possible | • Limited application (inconsistent and too-small supply of fabrics)  
• Labour-intensive |
| **Refibra**                               | Pre-consumer cotton waste (cutting waste from garment making) | • Lenzing (e.g. patagonia)  
• Replaces part of wood as raw material used in pulp fibre production  
• Commercially available  
• Research on increasing recycling content and use of post-consumer waste | • Same quality as raw material from wood  
• LCA-proofed environmental advantages | • Up to now just 20% recycling content possible  
• Just possible for undyed, homogenous pre-consumer waste |
| Re:newcell pulp | Cotton, viscose & other cellulosic fibres | • Post-consumer textiles are shredded, buttons removed, discoloured, etc.  
• Separation of cellulose fibres  
• Chemical solvent  
→ Molecular level  
→ Dissolving pulp  
→ Viscose fibre  
• Drying  
→ re:newcell pulp  
→ packaged into bales  
→ fed into the textile production cycle  
• Demonstration plant in Sweden producing 7,000 tons per year  
• Full scale plants with 30,000 tons planned | • Cost-effective environmentally friendly chemicals  
• Low energy consumption (exception: drying) | • Quality problems with high non-cellulose content  
• Broad spectrum of pollutants and dyes in the raw material  
• Small scale leads to high costs in initial stage |
| --- | --- | --- | --- |
| Innovative chemical polymer recycling: **Worn Again** | Recycling of synthetic (polyester) and natural fibres (cotton) | • Polyester is not depolymerized to monomers, but directly recovered  
• Small scale  
• Establishment of Recycling plants (Upscaling) planned | • Broad range of inputs  
→ Pure as well as blended materials can be used  
• 20% of impurities can be filtered out  
• Polyester of same quality as virgin equivalent | • High energy consumption  
• Higher costs than virgin materials |
| Innovative chemical polymer recycling: **Evrnu Regenerative Fiber** | Natural fibres (cotton fabrics) | • Prototype status  
• Pulping and breaking down cotton to fibre molecules  
• Removement of dyes / contaminants | • High quality fibres  
• 98% less water than virgin cotton | • High energy consumption  
• Higher costs than virgin materials |
| Relooping Fashion Initiative, Infinitied Fiber | Natural fibres (cotton rich textile waste and other biomaterials, like wood) | • VTT Technical Research Center of Finland, Infinitied Fiber Company  
1. Activation  
2. Carbamate cellulose dissolution technique  
3. Fractioning  
• Currently test-base on industrial scale, development towards industrial production | • No downgrading of fibres  
• Environmental-friendly | • Requires raw material in large quantities  
• Reliability is an issue |
| Innovative hydrothermal (chemical) recycling | Polyester and Cotton | • Hong Kong Research Institute of Textiles and Apparel (Partner: H&M)  
• Hydrothermal process with heat, water and less than 5% biodegradable green chemical  
• Pre-industrial size facility opened in September 2018 in Hong Kong  
• Recycling of cotton and polyester blends  
• Self separation without the need of prior high-quality sorting | • High energy consumption  
• No direct textile-to-textile recycling for cotton |