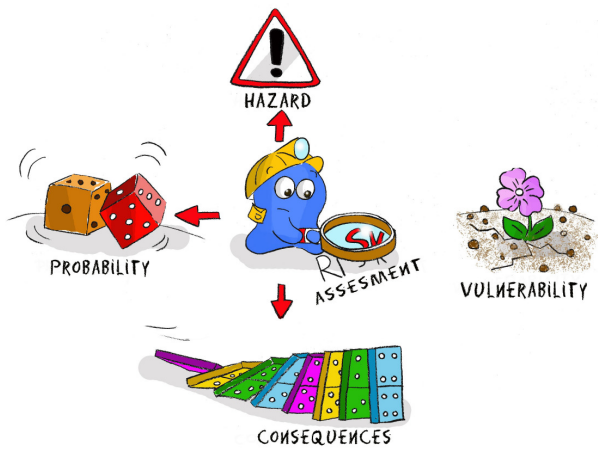
Plasma NICE

Risk Assessment & Life Cycle Assessment

Risk Assessment (RA)

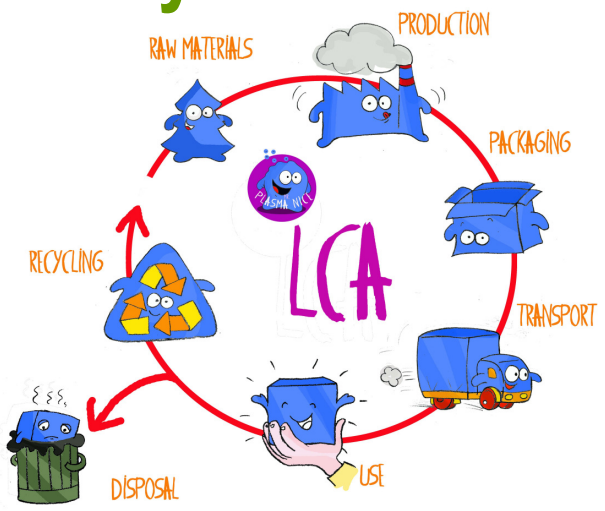


In the estimation of risk, risk is a complex function of:

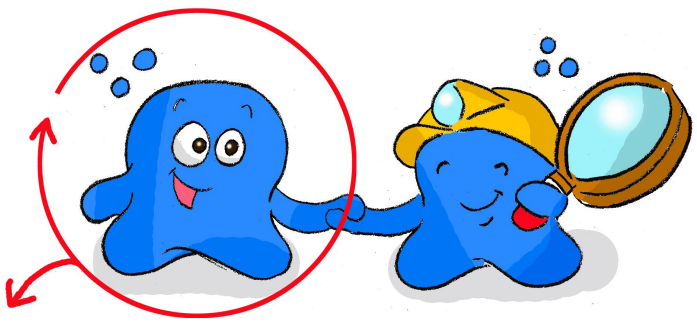
- The hazards connected with a certain system
- The probability that a hazard results in an undesired event
- The consequences of this event
- The vulnerability of the environment that is exposed

The PlasmaNice life cycle has been reviewed to identify stages with potential for nanoparticle exposure for workers, consumers and the environment. Risk analysis tools were selected according to the specific stage, combining newly developed and traditional tools, with the goal of handling uncertainties in a transparent way.
On the basis of this work, strategies have been formulated and recommendations have been made.

Life Cycle Assessment (LCA)



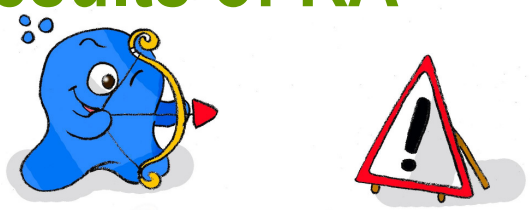
Life Cycle Assessment is a tool to assess the potential environmental impacts of a product, process or service along its entire life cycle, from cradle to grave, through the extraction of raw materials, production, transport, use until disposal.
When performing an LCA study, all environmental data are collected and impacts are calculated.
One of the strong points of this methodology is that it quantifies environmental impacts at different stages of the product, thus avoiding shifting potential environmental problems from one stage to another. LCA has widespread applications in product development and ecodesign, policy making, ecolabelling, green procurement. During the project, LCA was applied to analyze different processes and materials and measure their environmental impact. Alternative solutions were analyzed to evaluate the performance of different development options.



Why RA and LCA in this project?

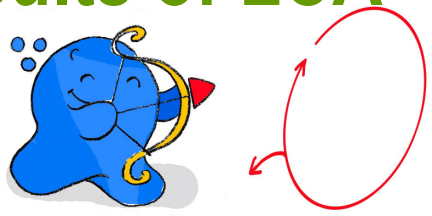
RA and LCA have been used in this project as design tools to assess environmental impacts, health and safety aspects of the new technologies and of the products to be developed. Technologies and products have been assessed based on a comparative approach with established processes and products. A new process should not provide a higher risk to workers and society than established processes and products. Safety should be evaluated in terms of occupational safety, human health, environmental exposure. Technologies, processes and products should be safe for workers, also in the case of accidents and spills during manufacture, products need to be safe for consumers and environmental exposure needs to be monitored closely to prevent accidents and efficiently manage the transport and waste treatment of coating material.
Different scientific studies advise using Risk Assessment and Life Cycle Assessment to support decision-making on nanotechnology.

Results of RA



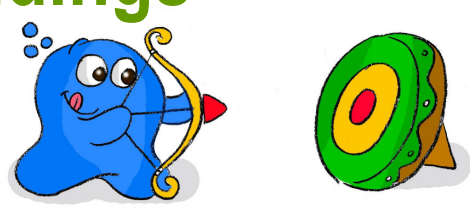
A preliminary assessment of plasma technology revealed that nanoparticles are only produced during the coating process. Small droplets containing nanoparticles which become airborne during the spraying are found to be the major hazard, but they are only produced during the coating process, while spills of the bulk solution is not seen as critical. For this reason the main potential source is expected to be close to the atomizer. As the nano sized coating is bound to paper, paperboard or film, it is assumed to be a negligible emission source. Thus a potential exposure with nanoparticles seems restricted to the workplace. This potential occupational health problem may need attention but is expected to be fully controllable with appropriate measures.
The findings do not detect other major safety issues in the workspace other than well known accidents such as hot surfaces, treatment of chemicals etc., which can be prevented with appropriate safety measures. Regarding consumers, there could be a possibility to regenerate nanosized particles depending on the degradation of the coating used, but at this stagethis is assumed to be of low likelihood due to the embedding of nano-silica in the product.

Results of LCA



During the project, LCA was applied to analyze different processes and materials. One example of such studies is the paperboard coating process, which could be used for packaging purposes, such as cups for beverages and boxes. The two coatings analyzed are LDPE and PLA and the object of the study was 1 m^2 of coated cardboard.
LDPE – Lowdensity polyethylene – a plastic made from petroleum
PLA – Polylactic acid – a polyester derived from renewable resources
This study has analyzed all processes from cradle-to-factory-gate. The use phase has not been included because it is generally assumed that it does not contribute considerably to the overall conclusions and because it is highly dependent on the characteristics of the specific product (packaging materials and disposable items). For this same reason in the waste management phase, although important, a generic waste collection by a standard lorry and incineration were considered. The study showed that the overall performance of PLA and LDPE is about the same, but the latter performs somewhat better in the total score because a lower quantity of LDPE coating is needed to give the same service. The greatest contribution to the overall impact comes from the paperboard raw material, the coating has a moderate effect and the extrusion process has very little effect.

Findings



As nanoparticles are only produced during the coating process, a potential exposure to nanoparticles seems restricted to the workspace and should be fully controllable with appropriate measures.
Research results on consumer risks show that further investigation is needed to refine risk evaluation of nanoparticles. Nevertheless, there is a low probability that nanosized particles regenerate when used in the final product.
Results indicate that environmental risks appear to be relatively low in both best-and worse-case scenarios.
Although the evaluation has been carried out with the best possible care and attention, assessing nanomaterials remains a particularly challenging matter because the availability of information regarding the toxicity of these substances is limited. For this reason it has been suggested that the precautionary principle should be applied.
The LCA study revealed that the environmental performance of PLA and LDPE is more or less comparable, although the former has a slightly lower performance due to a higher quantity of material needed to give the same service. In any case, the coating has a moderate effect on the environmentalperformance and the extrusion process has a small effect, while the largest contribution comes from raw materials.