PPP Project Annual Report 2018

General information	
PPP number	**TKI-AF-**16037
Title	*HIPUDA*
Roadmap/Umbrella	**Circulair**
Executive knowledge institution(s)	**Wageningen food and biobased research**
Research project leader (name + e-mail address)	**Rutger Knoop** **Rutger.knoop@wur.nl**
Coordinator (on behalf of private parties)	
Government contact person	**Jan van Esch**
Start date	**01-01-2017**
End date	**31-12-2018**

Approval coordinator/consortium	
The coordinator has assessed the annual report on behalf of the consortium:	√ approved □ rejected
Possible feedback on the annual report:	

Short content description/aim PPS
In this project, the goal is to increase the toughness of PLA with dimer fatty acids from vegetable oils or derivatives thereof. The aim is to develop a high impact food contact proof injection moulding PLA grades with a biobased content higher than 90% (w/w). The approach to achieve this goal is called dynamic vulcanization. A dimer fatty acid derivative (supplied by Croda) is added into a polylactic acid (supplied by Synbra) melt in an extruder and the dimer fatty acid derivative is cross linked subsequently. This will result in PLA with rubber like particles (cross linked dimer fatty acid derivative). The ratio dimer fatty acid: PLA will be varied and the mechanical properties, tensile strength, notched and unnotched impact resistance and falling dart will be determined.

Planning and progress	
Is the PPP going according to plan?[1]	This PPP goes strictly according plan
Have there been changes in the consortium/project partners?	There have been no changes in the consortium partners
Is there a delay and/or deferred delivery date?	There is a short delay and the project is extended until 1 june 2019 to allow for the trials at the industrial partners.
Are there any substantive bottlenecks? Provide a brief description	There are no substantive bottlenecks
Are there any deviations from the projected budget?	There are no deviations from the project plan
Do you expect a patent application to arise from this PPP?	The process itself is already patented but when this project is successful, the process and the material will be commercialized

Current summary of the project for the website Kennisonline

In this project, the goal is to increase the toughness of PLA with dimer fatty acids from vegetable oils or derivatives thereof. The aim is to develop a high impact food contact proof injection moulding PLA grades with a biobased content higher than 90% (w/w). This scientific challenge is both from industrial and societal point of view interesting because it can significantly widen the application areas of PLA; one of the best prized biobased and biodegradable plastics currently on the market. From the perspective of the agri-food industry the benefits are twofold. From the supply side point of view this development can lead to new added value applications of natural oil derivatives and increase the use of PLA made from fermentable sugar sources like corn and sugar beet. From a demand side perspective this development can open up the market for PLA for B2B and B2C food packaging in applications now dominated by petrochemical polymers like HIPS, PP and HDPE. From scientific point of view, reduction of the particle size by this technology is highly challenging. Reduction of the particle size will be of main importance and for that, a detailed study of the extruder design is incorporated in this project.

Highlights:

Three trails have been performed in 2018.

In 2017, initially a two-step procedure was evaluated. In the first step, the dimer fatty acid derivative (DFAD) was blended in various PLA grades with and extrusion process. In the second step, the dimer fatty acid was cross linked by the addition of an cross linker in the extruder. Due to the two steps, which also means two thermal treatments, this process is industrially less relevant. The industrial partners stated that a single procedure is preferred over a two step process. The single step process, blending the DFAD in PLA and subsequently cross linking in one step, was tested at the end of 2017. Unfortunately, the results of the single step process did not meet the properties obtained by the two step process.
In 2018, the main focus was on development of the best extrusion conditions and the main important part is the screw design of the extruder.
During the first single step process trials it appeared that the point where the cross linker was added was not the best location. In the second trail, the results were already improved by the addition of the cross linker on a more appropriate place. Finally, the last trial resulted in relatively homogenous distributed cross linked particles. This was proven by sheet extrusion of a sheet of 600 mm thickness. The appearance of the sheet was homogenous and no patterns of in homogeneities were observed. It was even possible to perform a vacuum forming step with the sheet to

[1] If applicable, use the explanation from the financial project report

create a cup shaped product. This findings made decide to perform extrusion trials for larger scale production to evaluate at the industrial partners. 40 kg material was made for HSV based on a slower crystallizing PLA to perform injection moulding tests of large, thick walled products. Similar material was made for Synbra to evaluate the potential for foaming of high impact PLA. For Haval, a fast crystallizing high impact PLA was produced to test this material on injection moulded products with thin walls.

Number of delivered products in 2018			
Academic articles	Reports	Articles in journals	Introductions/workshops
none	None	None	none

Appendix: Names of the products or a link to the products on a public website

Link naar Kennisonline/TKI AF:
https://www.wur.nl/nl/Onderzoek-Resultaten/Topsectoren/show/HIPUDA-1.htm