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**MouldPulp**

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**Development of Durable, Fully Bio-Based  
Thermoplastic Composites from Bioplastics and  
Pulp Fibres for Injection Moulding Applications**

Thomas Wodke



**Fraunhofer**

UMSICHT





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# Project Objectives and Main Tasks

## Background

- Promising wood-polymer concept DuraPulp® from cellulose pulp and PLA
- Fully bio-based
- Good mechanical properties
- Perceived naturalness and nice tactile properties
- Dyeing with clear colours possible

## Problem


- Lack of viable industrially production methods to make end consumer products

## Objective

- Development of a processing technology that allows to make injection moulded parts out of DuraPulp® but keeping the material identity



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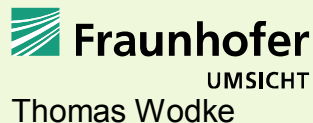
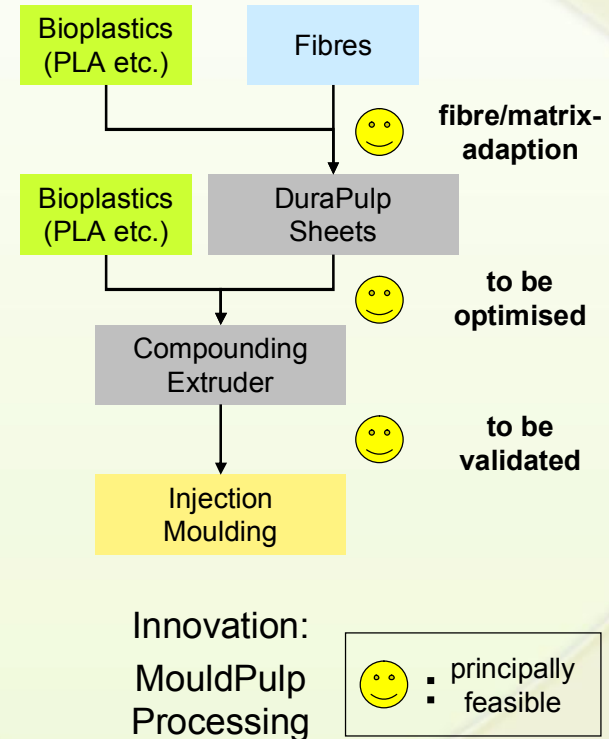
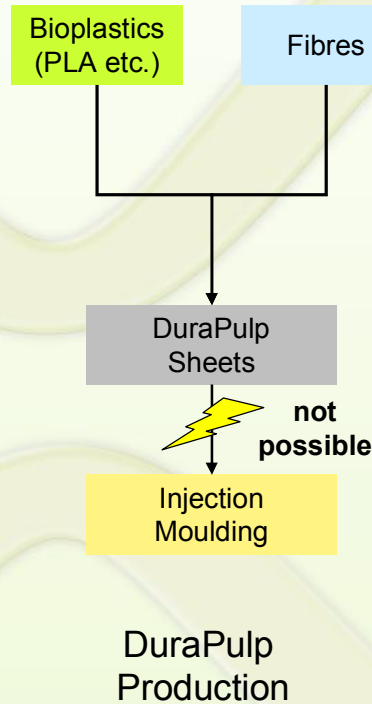
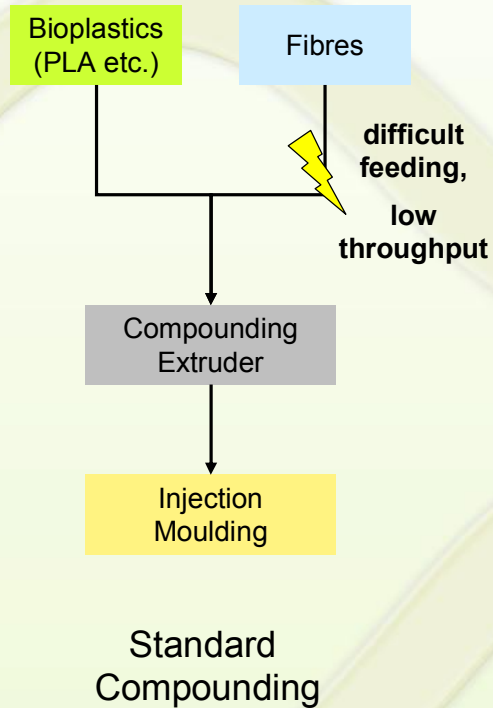
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# Project Objectives and Main Tasks



# Project Partners and their Roles

## Project team along the whole value chain

R&D Assessment Materials Manufacturing Market

**Fraunhofer UMSICHT**  
(Germany)  
Material development bioplastics

**Södra**  
(Sweden)  
Raw materials &  
product development

**Hammarplast Consumer AB**  
(Sweden)  
Consumer plastics products

**Innventia AB**  
(Sweden)  
Material development pulp  
Developer of DuraPulp

**FKuR Kunststoff GmbH**  
(Germany)  
Compounding company for bioplastics

**nova-Institut GmbH**  
(Germany)  
Techno-economic and  
ecological assessment

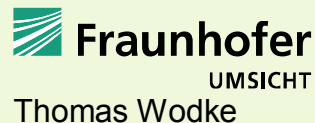
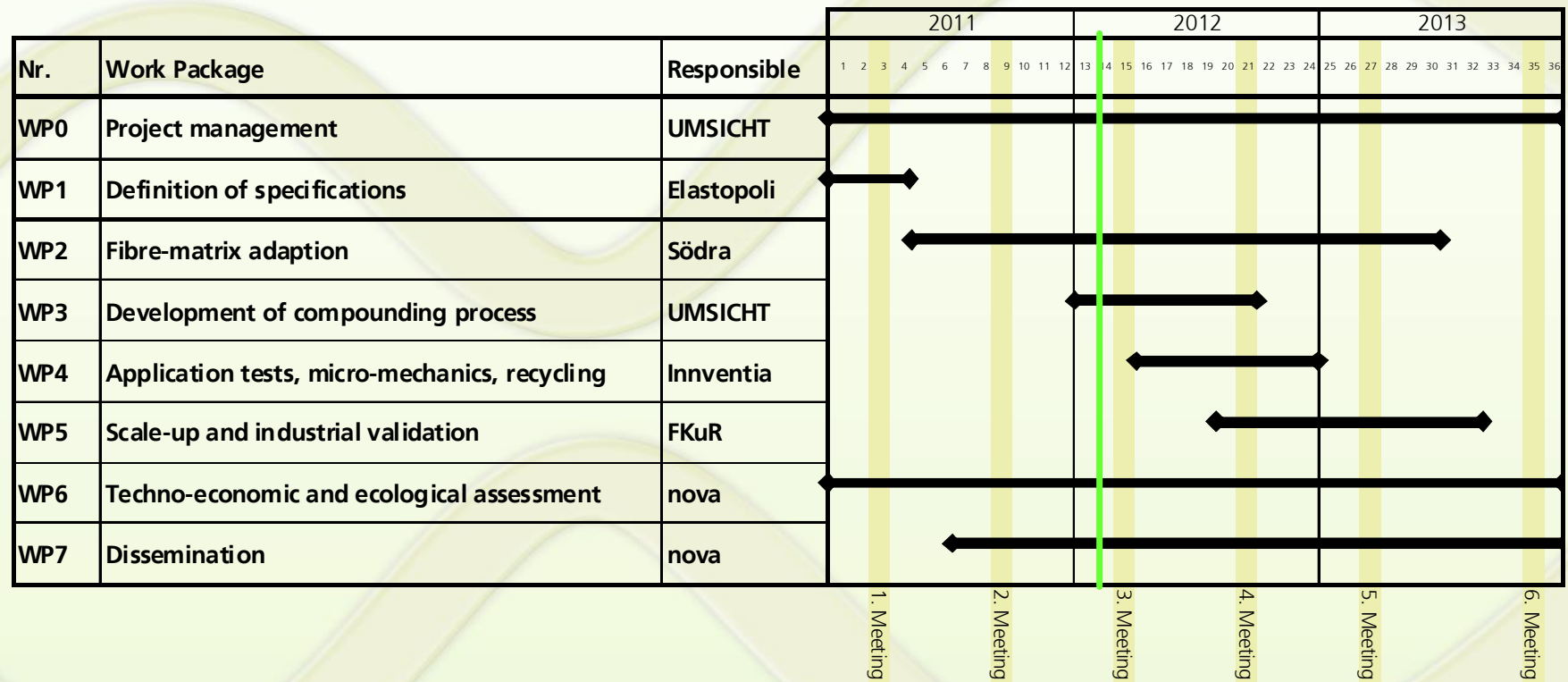
**Elastopoli Oy**  
(Finland)  
Application development



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# Project Partners and their Roles

## Work packages and time table



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# Project Highlights

## Intermediate results

- 1st meeting in March 2011:  
Extensive demonstration of DuraPulp® process
- Finishing WP1 in April 2011:  
Goal is the perceived naturalness
- Market survey:  
Intermediate results in June 2011
- Dissemination:  
Homepage [www.mouldpulp.com](http://www.mouldpulp.com),  
exhibitions, publications
- 2nd meeting in September 2011:  
Evaluation and adaption
- WP2 & WP3:  
Preselection of fibres and PLA-grades  
Handling and metering  
Pelletizing and milling technologies



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# Project Highlights

**WP1: Definition of specifications (final results)**

**WP2: Market survey (intermediate results)**

**Application fields: Furniture, cases / boxes, instruments, toys**

## **Mechanical properties**


- Tensile strength 30 to 80 MPa; Flexural modulus 2 500 to 5 000 MPa
- Maximum service temperature 50 to 80 °C
- Good impact resistance also at low temperature
- Breaking without any sharp edges or splinters

## **MouldPulp material works in an injection process**

- Normal machinery without any special device
- Highly automatic and advanced production process
- Stick-free ejection from the mould
- Short cycle times



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# Project Highlights

**WP1: Definition of specifications (final results)**

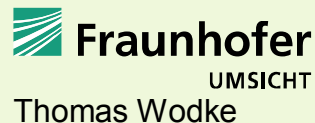
**WP2: Market survey (intermediate results)**

## Conclusions

- Mechanical properties can probably be achieved
- Natural impression is the main material advantage
- Pretreatment of pulp fibres to allow efficient and proper metering and dosing is the main technical topic



DuraPulp®







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# Project Highlights

## WP3: Fibre-matrix adaption

## WP4: Development of compounding process

### Basic raw material

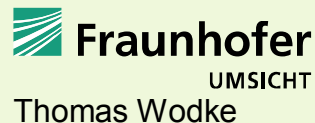
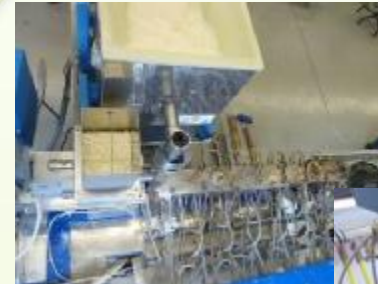
- DuraPulp® means cellulose pulp and PLA fibre
- DuraPulp® as bulk
- DuraPulp® as sheets
- PLA injection moulding grades

### Intermediate goal

- Meterable DuraPulp® for compounding

### Goal

- Free-flowing granulates for injection moulding
- High fibre amount
- Natural impression





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# Project Highlights

**WP3: Fibre-matrix adaption**

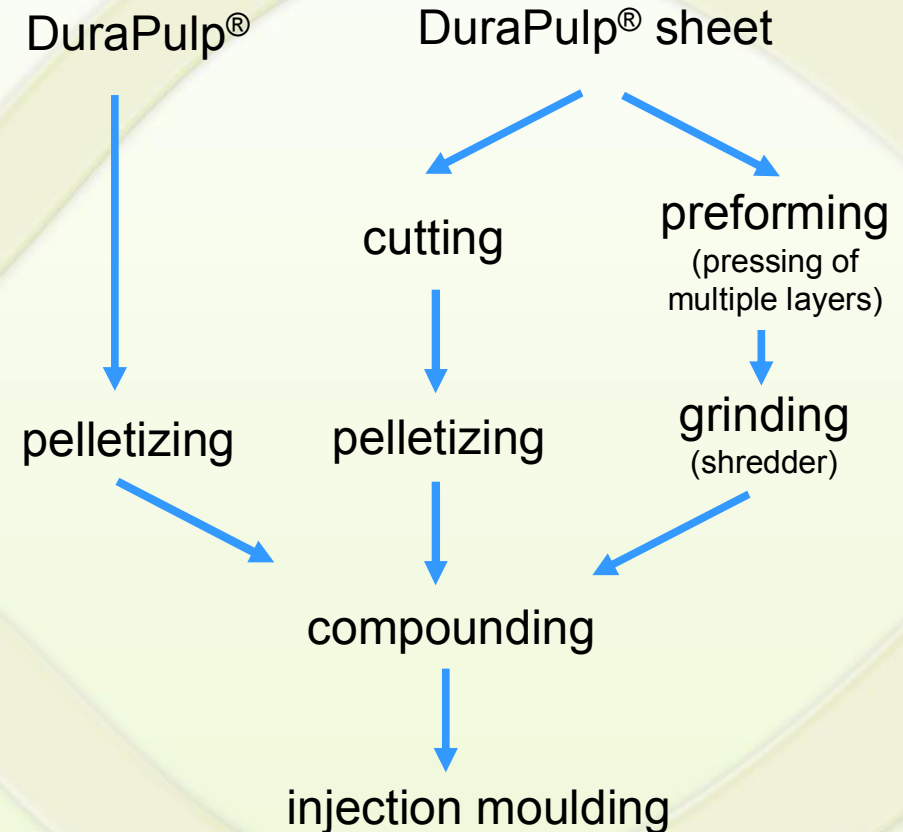
**WP4: Development of compounding process**

## Conclusions

- Use of DuraPulp® bulk
- Decision at 2<sup>nd</sup> meeting

Caused by:

- Reduced thermal stress
- Reduced costs





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# Project Highlights

## WP3: Fibre-matrix adaption

## WP4: Development of compounding process

### Current issues and tasks

- Preselection of PLA injection moulding grades finished
- Investigation of the influence of lignin content on yellowish discoloration
- Investigation on additives are under examination:
  - Impact modifiers
  - Coupling agents
  - Bleaching agents
- Optimizing the process steps from bulk to injection moulding
- Compounding and injection moulding trials
- Material testing



Impact tests





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# Expected Impact and Target Groups

## **Novel natural fibre reinforced composite DuraPulp®**

- 100% bio-based composite (PLA & pulp)
- Injection moulding

## **Significantly increasing of using natural fibre reinforced biopolymers**

## **Open up the market of consumer products**

- High efficient processing technology (IM)
- Durable, high-quality products
- Light-weight, naturally impression, dyeable
- Good eco-balance



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# Expected Impact and Target Groups

## **Innovative bio-based consumer products for a worldwide market made in Europe**

- Use of cellulose pulp strengthens the forest-based value chain
- Novel and modified processing technology creates new opportunities for machine manufacturers
- Novel design concepts for consumer products
- Generation of manufacturing capacities

**In accordance to the European Lead Market Initiative focused on bio-based products**



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# Added Value from Transnational Approach

**Multidisciplinary and international approach is required to reach the project goals:**

- Preparation of functionalized fibres (Innventia, Södra)
- Development of bioplastics (Fraunhofer UMSICHT)
- Plastics processing (FKuR, Hammarplast, Elastopoli)
- Techno-economic and environmental assessment (nova, Innventia)


**Trans-European approach due to long-termed regional knowledge build-up:**

- Sweden: Wood and pulp processing
- Germany: Bioplastics production and promotion
- Finland: Fibre reinforced plastics

**In addition the transnational approach will help to disseminate the project results and to transfer the technology into the industry.**



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## MouldPulp

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**Thank you for your attention.**