

# Komposittaktiviteter ved NTNU

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# COMPOSITE GROUP



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Nils Petter Vedvik



Marie Le Baillif Holweck



Jörg Höyland



Sjur Lærdal



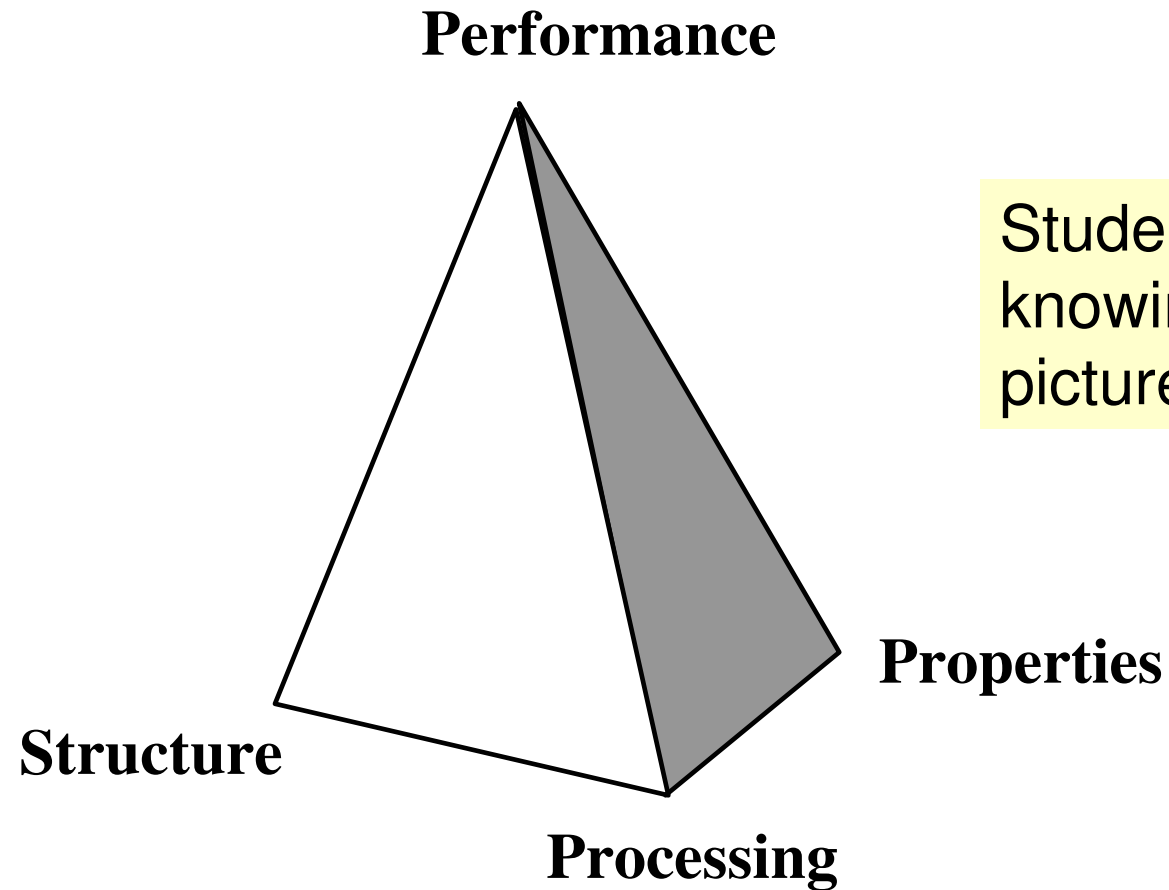
Asbjørn Solberg



Børge Holen

**+ 8 MS  
students**

# Teaching Composites



Students should leave IPM knowing the complete picture & have a specialty

## Materials - Properties

- Composites\*
- Polymers\*
- Adhesives
- "Large Composites"
- New Fiber Matrix  
Combinations  
(renewable)
- New Insulation Materials\*
- Material Interfaces\*
- Smart Materials

- Static\*
- Impact
- Fatigue\*
- Stress Rupture\*
- Environmental Degradation\*
- Development of Test Methods\*
- Reliability linked to physical properties
- Knowledge Based Engineering for  
multi-materials solution \*
- Link Micro-processes to Macroscopic  
Response\*

\* current projects

# PROCESSING

- **Resin Infusion\***
- **Filament winding\***
- **Extrusion\***
- **Probably also others in the future (pre-preg)**

**Process control\***

**Critical Parameters\***

**Establish link to mechanical performance\***

\* current projects

## APPLICATIONS – current focus

Offshore

Arctic

Energy

Alternative Energy

Ships

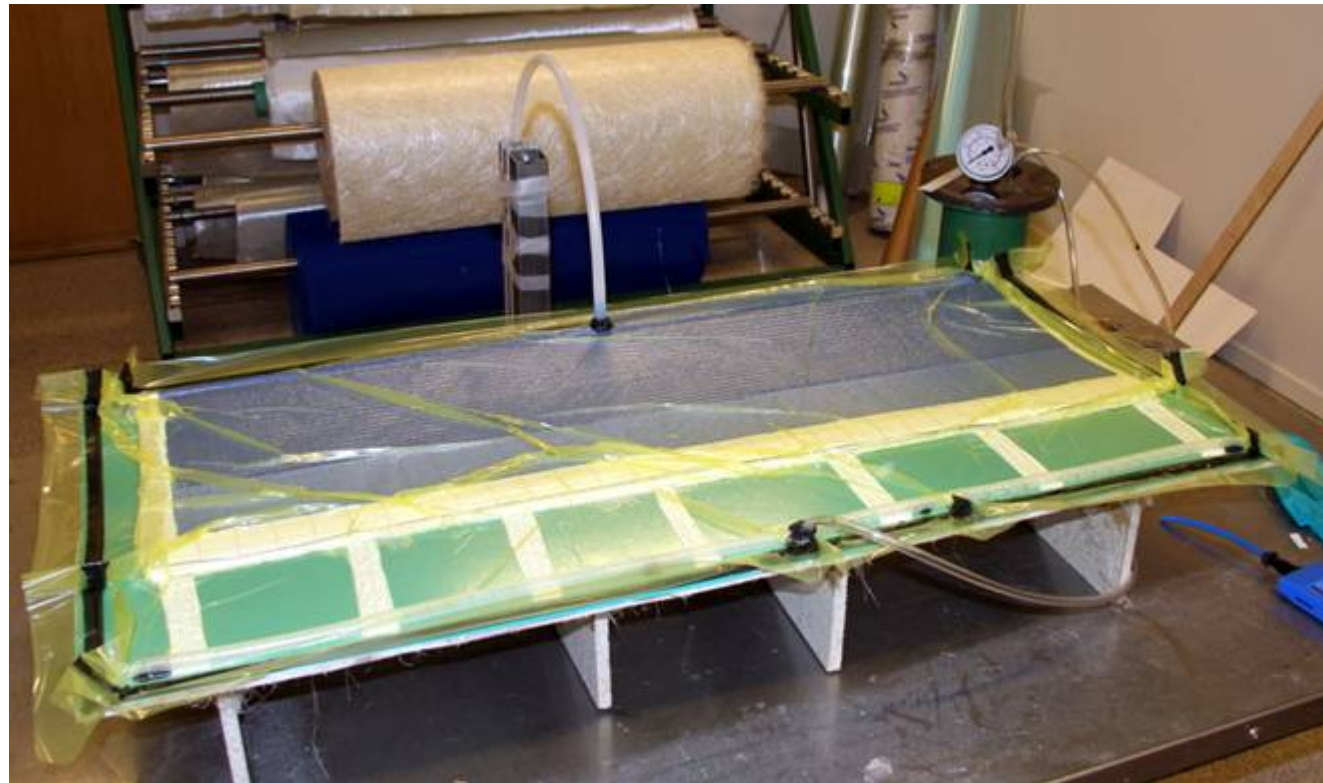
Possibly others

Similar materials can be used in many industries

# NTNU kompositt laboratorium



# Resin Infusion



# Resin Infusion



- Standard Method
- Identify Process Parameters
- Develop new method for thick laminates

# Laminate Testing

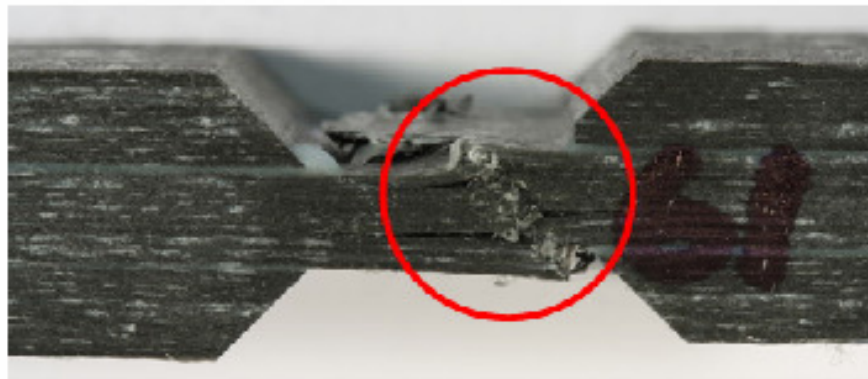


## Compression Testing

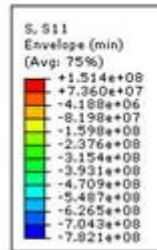


good compression failure

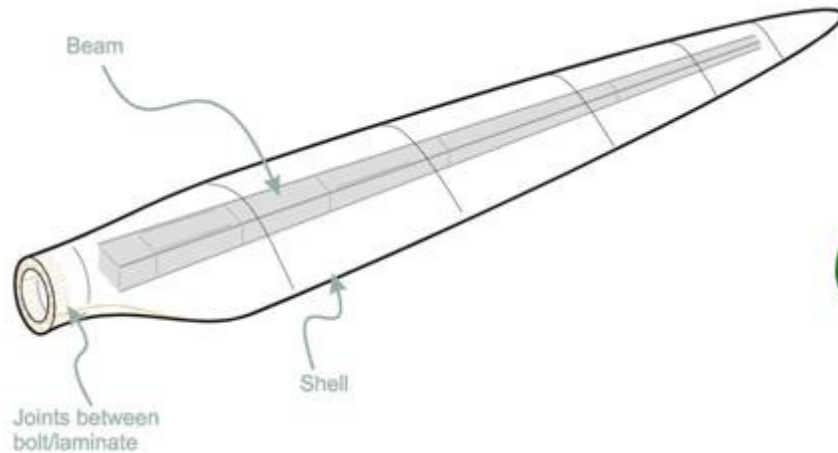
shear failure



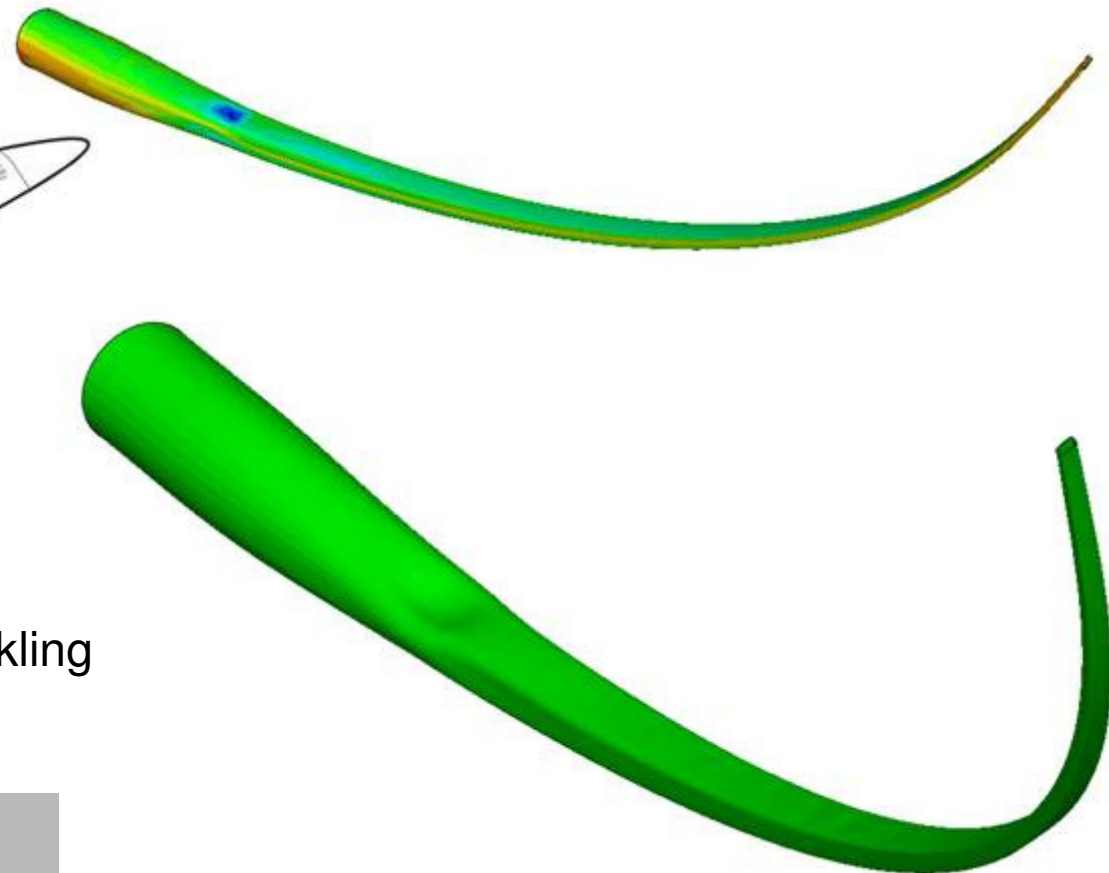
# Wind Turbine Blades - Spar



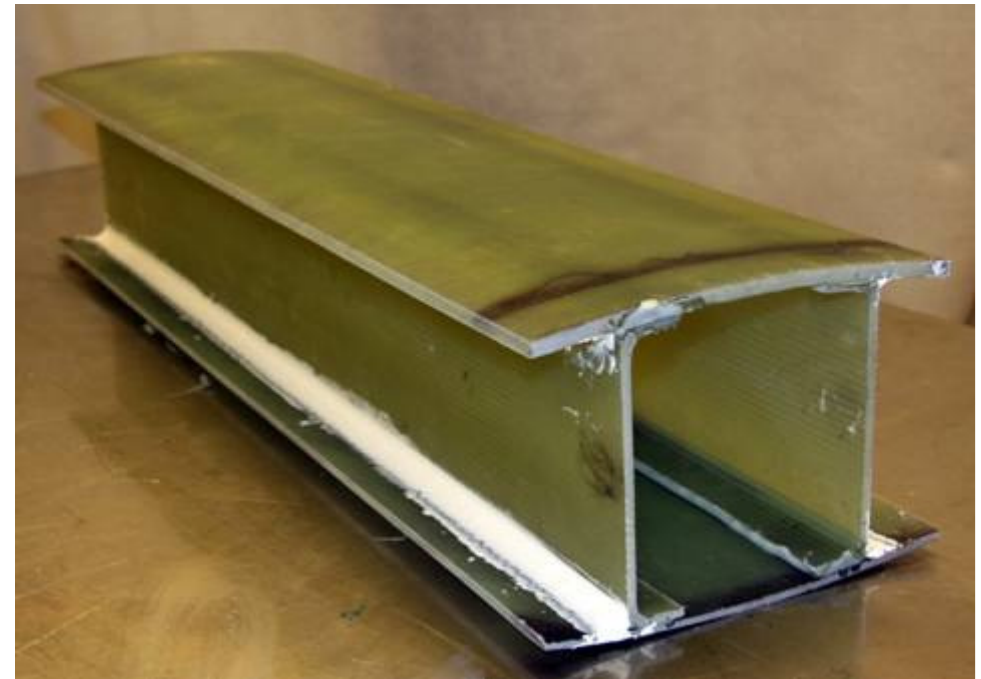
FE analysis



Buckling



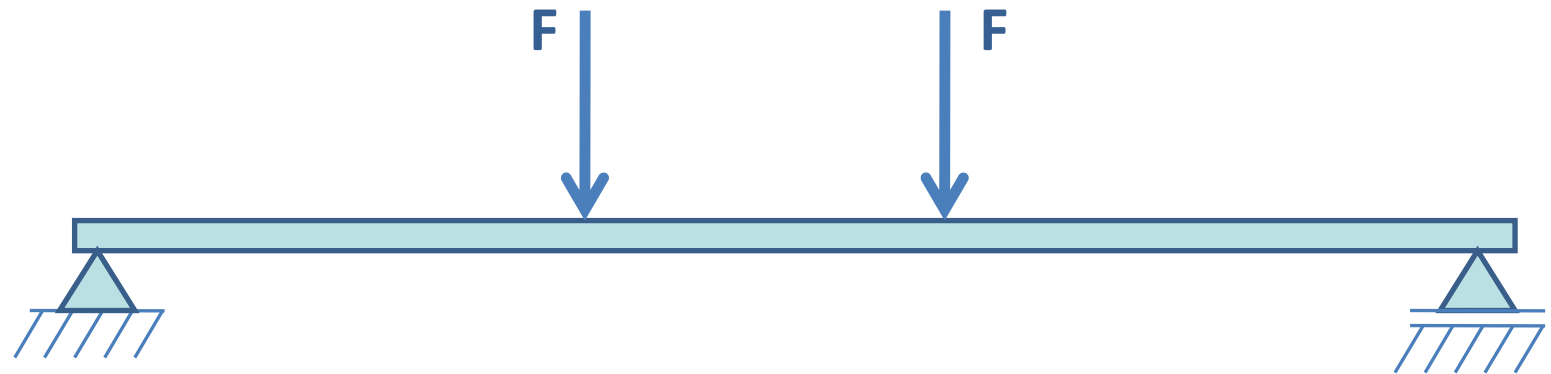
# Building of Test Spar (preliminary)



# Testing of Spar



Labforsøk av 6m bjelke



# Pre-Pregs

- Important aero space material
- Currently no activities at NTNU  
(except Eco Marathon built by Kongsberg)
- Have a hot press and could build a small autoclave
- Have previous experience
- Large wind turbine blades need materials with higher modulus

we may have a novel solution to obtain this

pre-pregs may also be a solution



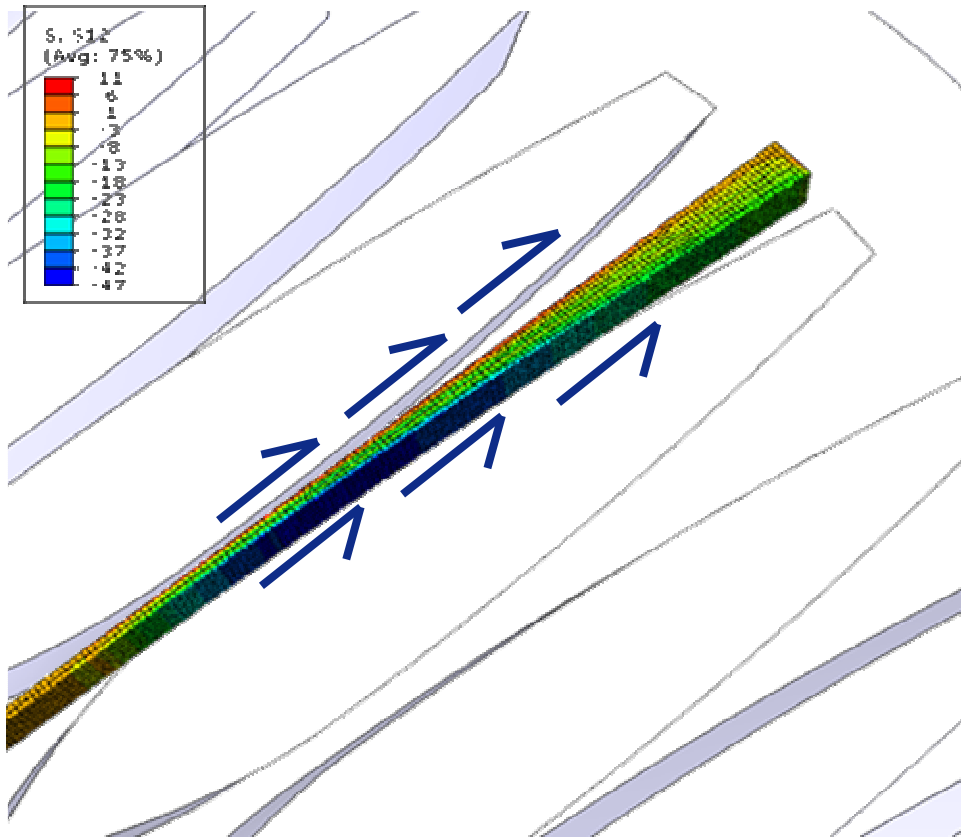
# Filament Winding

Have just set up a simple winding machine

Will be initially used for a drilling related project (offshore)

Various offshore related projects are planned (pipes, risers)

# Metal-composite interface for tubulars



Enhanced load transferring capacity

Automation and repeatable production (filament winding) made feasible

# Cellulose fiber composites

## Pelletization



- Moisture
- Chemicals

1

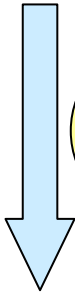


## Cellulose pellets



- Compactness
- dimensions
- Density

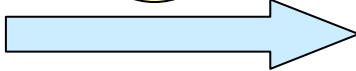
2



## Extrusion

- Feeding method
- Feeding zone

3



## Composite

- Fiber length
- Fiber dispersion

# Buoyancy - Insulation Materials

Important Group of Materials

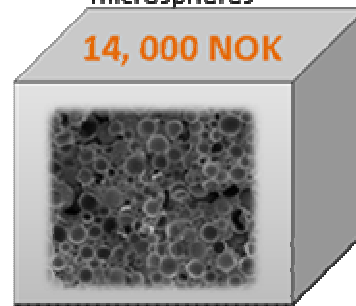
Currently one project to develop an extremely cheap material for high external pressures.

Results look promising so far



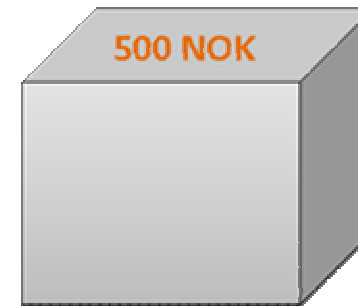
Today's  
microspheres

14,000 NOK



Our alternative filler  
material

500 NOK



Costs for 1 m

# Long Term Properties

Currently one MS looking at resistance of epoxy and rubber to Diesel (crude oil).

Planned to put more emphasis on this area.

We are currently building a stress rupture rig.

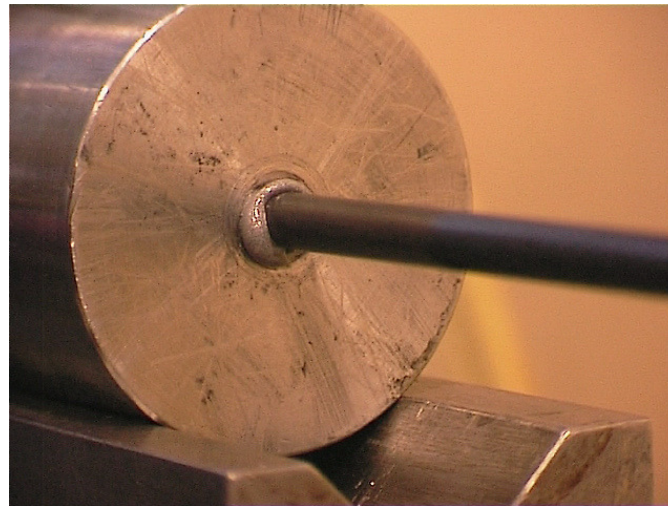
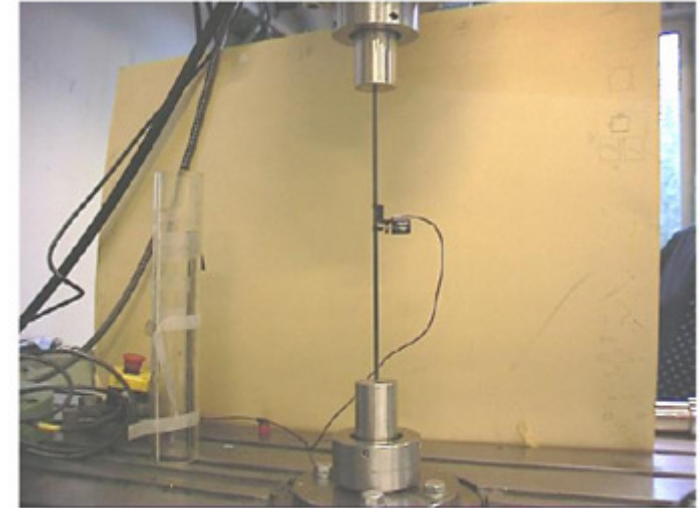
Other equipment is being planned to combine environmental and mechanical loading.

A link to the micro-mechanisms (atomistic scale) will be needed to understand effects.

# Composite Rods



e↑



f↑

Short and long term testing

New stress rupture rig is being built

Developed a new joint, will be tested and improved

## New Projects - Sintef

Smooth Pipe - Long term degradation of liners (NFR-Sintef)  
start May 2008 - Post Doc

Arctic Materials – Behavior of composites in harsh climates  
start Jan. 2009 – PhD (NFR-Sintef)

Demanding Polyolefin Applications - Insulation Materials –  
mid 2009 – PhD (NFR-Sintef-Brederow Shaw)

# New Projects

Development of mechanical joint for rods

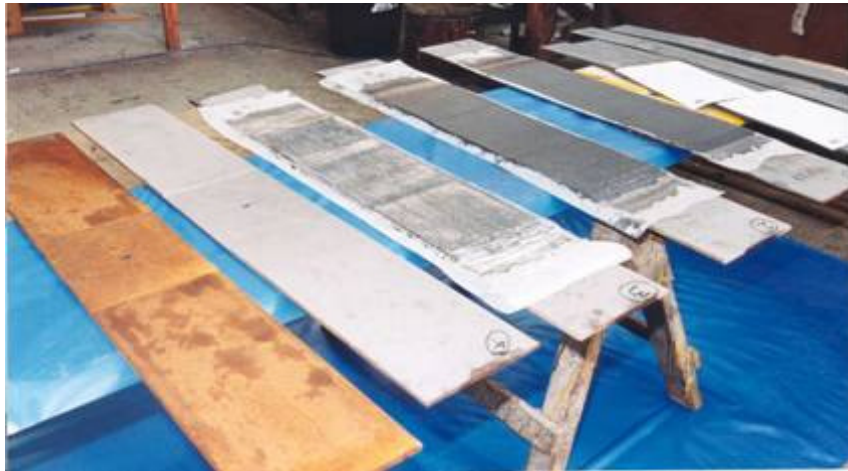
Idefond, Oil industry

Offshore related projects (under discussion)

Aker Solutions, Umoe Mandal, +++

CoPatch – Repair of metal cracks with composite Patches???

EU project proposal – submitted May 2008



known method in aerospace  
new challenges with thick plates  
previous projects at DNV + NTNU students

# CONCLUSIONS

Many exciting projects

More plans for the future

We are looking forward to support industry and to develop new solutions

