

## Metallic Liner Hydroforming – Experimental Tests, Modelling and Numerical Simulation

### Objectives

- ❖ Determination of hardening law for material shaped as tube and adapted to the hydroforming process
- ❖ Simulation of hydroforming of metallic liner by FEM using LS-Dyna
- ❖ Comparison of hydroforming and deep drawing processes and evaluation of liner quality

### Achievements

#### Tube bulging tests – hardening law determination:

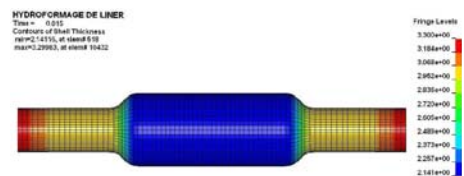
- ❖ Realization of an experimental device for tube bulging test
- ❖ Development of an analytical model based on a novel geometrical approach
- ❖ Validation with FE simulation



Bulged tube with bursting

#### Metallic liner hydroforming – finite element simulation:

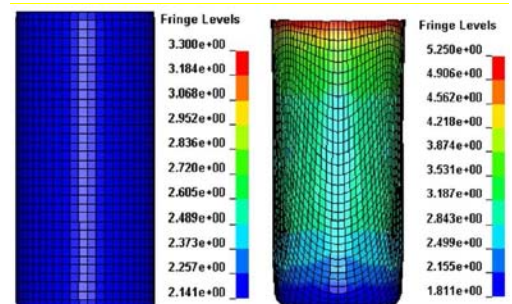
- ❖ Hydroforming simulation of high volume capacity tanks
- ❖ Optimization of the hydroforming loading paths
- ❖ Study of the sensitivity to initial thickness distribution and volume capacity



Thickness distribution on a hydroformed tube

#### Comparison between drawing and hydroforming:

- ❖ **Hydroforming :**  
 One pass process, seamless tank manufacturing, homogenous thickness distribution
- ❖ **Deep drawing :**  
 Cheaper raw material, seamless tank manufacturing, better known and controlled process



Thickness distribution – Comparison between hydroforming and drawing

### Future Perspectives

- ❖ Evaluation of the limitations of the analytical tube bulging modelling (bulging area length, material anisotropy)
- ❖ Simulation of a hydroformed liner enrolled with a composite structure: behaviour under pressure
- ❖ Realization of an experimental device to perform hydroforming: realization of metallic liner prototypes, influence of process on material properties for hydrogen storage

<p><b>Partners</b></p>	<ul style="list-style-type: none"> <li>❖ CNRS : FEMTO-ST Institute – Department LMARC</li> </ul>  	<ul style="list-style-type: none"> <li>❖ ADEME</li> </ul> <p>Funding for R. Velasco's Ph. D thesis</p> 
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<p><b>Website</b></p>	<p><a href="http://www.storhy.net">www.storhy.net</a></p>
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 The project partners wish to thank the European Commission for financial support of the Integrated Project StorHy– Hydrogen Storage Systems for Automotive Application (Contract No.: SES6-CT-2004-502667) within the 6<sup>th</sup> RTD Framework Programme.