

CHALLENGES OF INTEGRATING RESILIENCE IN LIGHTWEIGHT COMPONENTS FOR THE HYDROGEN INDUSTRY

NEW WAYS IN COMPOSITES BY PIONEERS FOR FUTURE

Founded in 1984, the Connova Group is one of the pioneers of the composite industry. We are a certified aviation manufacturer for composite parts. From R&D to industrialisation. Our core competence is precision. We are located in Switzerland and in Germany (Dresden) with 100 employees.



WHY DO WE NEED RESILIENT PROCESSES SO URGENTLY?

- We rested on our oil reserves
- Paris Climate Conference targets puts time pressure on us (& Ukraine war)
- Mature products for hydrogen technology are immediately needed (tank, fuel cells etc.)
- Resilient processes for mass production are needed right away



WHY DO WE NEED RESILIENT PROCESSES SO URGENTLY?



INTEGRATING RESILIENCE BY SMART PROCESS DEVELOPING

Classical approach for process development:

1 Feasibility Phase

1. Design, construction and production of a very first demonstrator

 successful feasibility

2. Manufacture 2 identical demonstrators

 proof of reproducibility

3. Production of component batch of 5 pieces

 determination of the tolerance range for the production process

Feasibility level is validated on the basis of 8 components within a production time of 2 weeks → gate to pre-series

INTEGRATING RESILIENCE BY SMART PROCESS DEVELOPING

Classical approach for process development:

2 Pre-Series Phase

1. Design & execution of 1 production day
 - determination of the effects of production start-up and shutdown
2. Execution of several production days in one quarter
 - determination of climate-related process fluctuations
3. Measure component wear
 - estimate service life

Pre-series level is validated on the basis of 50 components within production time of 3 months → gate to series

INTEGRATING RESILIENCE BY SMART PROCESS DEVELOPING

Classical approach for process development:

3 Series Phase

1. Observe production for 1-2 years
 - effects of annual climate fluctuations and large material batches
2. Returns from use
 - derivation of repair concepts
3. Measure component wear
 - estimate service life
4. Validation of design assumptions and simulations for follow-up project

Series level is validated on the basis of 2,000 components within production time of 2 years → gate to tested series

2 weeks feasibility phase
+ 3 months pre-series phase
+ 1 year ramp-up serial capacity
+ 2 years serial production

= a long time

**How can we find
a shortcut?**

- 2 weeks feasibility phase**
- + 3 months pre-series phase**
- + 1 year ramp-up serial capacity**
- + 2 years serial production**

= a long time

INTEGRATING RESILIENCE BY SMART PROCESS DEVELOPING

Use the feasibility phase to anticipate serial production and find out range of deviation/tolerance:

Necessary:

- one tooling
- one material batch
- one machine
- one worker

Connovas' approach:

- many toolings
- many material batches
- many machines
- many workers

realistic tolerance range → a controllable process → resilient process
→ additional costs saved in serial production

LEARNING NO. 1

„Testing has to be less expensive than digital simulation!“

- There is ridiculously little capacity for testing in Germany
- We need factor 1,000 testing capacity
- H₂ components must be tested under high pressure & cryogenically with the real medium hydrogen
- Static + dynamic + compressed service life simulation

LEARNING NO. 2

***„New composite standards are urgently needed.
No longer black metal norming!“***

- As long as there are no standards for the development of composite hydrogen components and as long as we use 200-year-old standards from 'steel pressure vessel construction', development of hydrogen technologies will not succeed
- An anisotropic material must be designed and normed anisotropically
- Instead of being guided by black metal standards a physical approach should be taken

LEARNING NO. 3

**Come to Connova.
Our approach is the controlled
and precise material
processing for minimal safety
factors to avoid useless
weights and costs!**

Thanks for your
attention! Thanks for
waking up! Thanks for
pushing **hydrogen**
industry forward!



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