Defects in glass fibre-reinforced plastics
Examples from industrial practice

Institute for Plastics
Contents

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1. Causes of defects
2. Examples of defects
Breakage/buckling of a pipe

**EXAMINATIONS**
- Determination of wall thickness
- Examination of laminate structure
- Determination of Young's modulus
- Recalculation using finite elements

**SOLUTIONS**
- Preventive: Examination of design
- Corrective: Pipe replacement

Non-conforming design – increased compressive stress and pronounced buckling tendency
2. Examples of defects

Pipe leakage

- Visual examination
- Theoretical assessment of resistance to chemicals

Solutions:
- Preventive: Select material suitable for the application or medium
- Corrective: Replace pipe / restrict applicable media

Selection of non-conforming materials (not resistant to chemicals)
2. Examples of defects
Nozzle broken off from a tank

**EXAMINATIONS**
- Visual examination including comparison against requirements
- Inspection / re-calculation

**SOLUTIONS**
- Preventive: Examination of design / information
- Corrective: Installation of a new nozzle

Non-conforming dimensioning / design
2. Examples of defects

Breakage of a skirt-mounted tank

- Visual examinations
- Recalculation using finite elements
2. Examples of defects

Breakage of a skirt-mounted tank

Transition zone with filler

- **Elongation**

- **Stress**

Transition zone without filler

- **Elongation**

- **Stress**
2. Examples of defects

Breakage of a skirt-mounted tank

**EXAMINATIONS**
- Visual examinations
- Recalculation using finite elements

**SOLUTIONS**
- Preventive:
  - Examination of design / regular checks by officially authorised experts
- Corrective:
  - Exterior/interior over-lamination

Non-conformities in design (impermissible outer fibre strain in axial direction – dimensioning)
2. Examples of defects

Defect in flange

EXAMINATIONS

- Visual examination (laminate structure)
- Examination of dimensioning
- Analysis of material properties

SOLUTIONS

- Preventive:
  Compliance with the requirements of the relevant standards/
  Personnel qualification
- Corrective:
  Replacement of pipe/flange

- Non-conformities in production (reinforcement structure weakened by inadmissible processing)
- Non-conforming assembly
2. Examples of defects

Defect in a tank

- **Visual examination**

**EXAMINATIONS**

- **Preventive:** Surveillance of production, correct design suitable for operating conditions
- **Corrective:** Manufacturing of a new tank or tank rehabilitation

**SOLUTIONS**

- **Non-conforming design**
- **Non-conforming production**
- **Non-conforming operating conditions**
2. Examples of defects
Shearing of a threaded connection

- Material analysis
- Microscopy
- Checking of the conditions of assembly/use

EXAMINATIONS

- Preventive: Surveillance of production/ qualification of assembly staff
- Corrective: Replacement of pipes

SOLUTIONS

- Non-conforming material
- Non-conforming assembly
2. Examples of defects
Osmosis blistering on a tank

- Visual examination (macroscopy / REM)
- Measurement of pH value
2. Examples of defects

Osmosis blistering on a tank

Fibres undamaged

Fibres badly to significantly damaged
2. Examples of defects
Osmosis blistering on a tank

Fibres subsequently completely dissolved
2. Examples of defects
Osmosis blistering on a tank

EXAMINATIONS
- Visual examination (macroscopy / REM)
- Measurement of pH value

SOLUTIONS
- Preventive:
  Periodic inspection
- Corrective:
  Removal of the chemical resistant lining and, if necessary, the load-bearing laminate / Application of new layers

Non-conforming design and/or operating conditions
2. Examples of defects
Dry pultruded profiles

- Glass content / Ashing
- Dye penetrant testing
- Visual examination (microscopy)

**Non-conforming production (insufficient impregnation of the glass fibres)**

**EXAMINATIONS**

**SOLUTIONS**

- Preventive: Adjustment of tolerances and requirements
- Corrective: Scrapping and re-production with intensified surveillance
2. Examples of defects
Shrinkage cracks on pultruded profiles

**EXAMINATIONS**
- Visual examination

**SOLUTIONS**
- Preventive:
  - Complete specification
- Corrective:
  - Scrapping and re-production with intensified surveillance

- Selection of non-conforming material (resin reactivity)
- Non-conforming design (layer structure)
- Non-conforming conditions of production (tempering, run time)
3. Prevention of non-conformities

Definition of operating conditions

Qualification of personnel

Consulting services

Surveillance
THANK YOU FOR YOUR ATTENTION!

Should you have any questions, please do not hesitate to contact us.

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