Workshop on ageing of district heating pipes

Hosted by SIS and RISE

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Welcome

- Thank you, SIS
- The overall purpose is to link ongoing research projects to standardization work
- Three projects
  - Effects of mechanical loads on ageing of district heating pipes (Energiforsk)
  - Long term effects of repetitive axial loads on DH pipes and their importance for service life (Swedish Energy Agency)
  - IEA DHC Annex Task Shared Project 6: Status assessment, ageing, lifetime prediction and asset management of District Heating Pipes
- Previous project report from 2022 by RISE
  - https://energiforsk.se/program/futureheat/rapporter/liftetime-predictions-and-status-assessments-2022-872/

Agenda Rev 2

1. Opening of the meeting with a welcoming statement by SIS and RISE
2. Short presentation of the people present: Please, try to limit yourself to ONE minute, give your name, affiliation, and few words about your work/company
3. Introduction by RISE
4. To get an interactive workshop we change between introductive presentations and discussions
5. Views on conditions of district heating networks
    a. Introduction by RISE
    b. AGFW: Failure mechanisms after losing the adhesion & effects of loads on cushions
    c. General discussion
6. Views on other failure mechanisms besides loss of adhesion (This issue can be extended to all types of DH pipes)
    a. Introduction by RISE
    b. Swedenergy: Failure mechanisms
    c. General discussion
7. Views on status assessment methods
    a. Introduction by RISE
    b. IPF & IMA: Thermogravimetric Analysis: A tool for status assessment in pre-insulated pipes
    c. General discussion
8. Views on accelerated ageing and lifetime estimations (temperature, time, models, tests, evaluations)
    a. Introduction by RISE
    b. RISE: Accelerated ageing and lifetime estimations –Standardization vs Research
    c. General discussion
9. Summing up, conclusions
10. Closing of the meeting

Purpose

- Compile knowledge about the condition of the district heating (DH) networks
- Compile other failure mechanisms than loss of adhesion for pre-fabricated rigid DH-pipe
  - Also failures for concrete ducts and flexible pipes can be discussed
- Compile knowledge about status assessment methods
- Agree on conditions for accelerated ageing or compile remaining verification tests that needs to be done before we can agree (temperature, time, tests, evaluations)
- Compile knowledge about lifetime estimations (models, tests, evaluations)
  - What should be done to achieve better lifetime estimations?

Status of DH networks

- Most pre-fabricated rigid DH pipes examined in previous project finished 2022, had **sufficiently good status for continued operation**
  - Pipes had **not** been exposed to high operating temperatures for many years (less than 30 years at 95 ° C)

- AGFW: Failure mechanisms after losing the adhesion & effects of loads on cushions

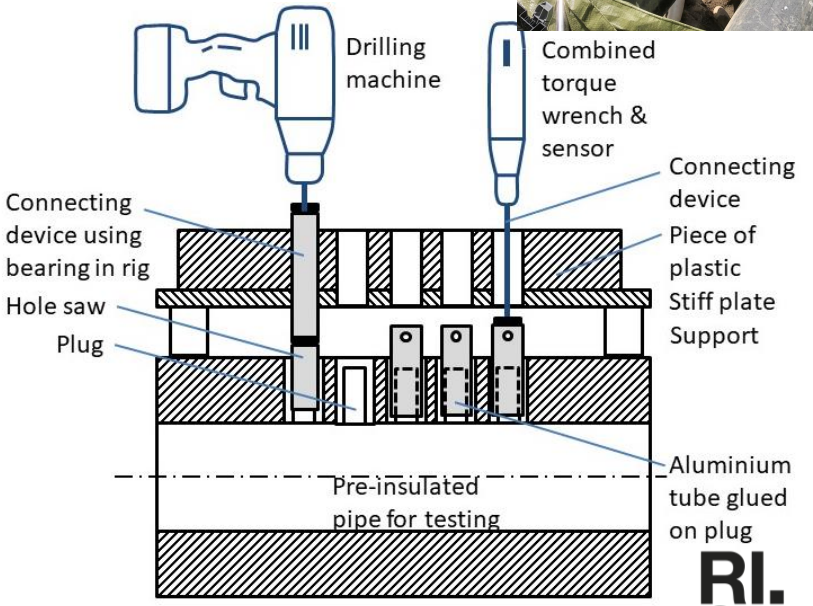
Other pipes and failure mechanisms

- For pre-fabricated rigid DH pipes many scientists have studied the failure mechanism loss of adhesion
- Which other failure mechanisms should be considered?
- We may treat **ALL** types of DH pipes
- Rigid DH pipes
  - Leakage at casing joints (caused during installation, high temperatures of casing with shrink fit joints)
- Concrete ducts
  - Corrosion of service pipes from outside
- Flexible pipes
  - Degradation of service pipes (PB, PEX, …)
  - Degradation of PUR insulation due to diffusion of moisture throw plastic service pipes

- Swedenergy: Failure mechanisms

Status assessment methods

- Tests for determining the status
  - Mechanical shear strength tests
  - FTIR analysing chemical structure
- RISE PipeOpsy (pre-fabricated single rigid DH pipes)
  - Field tests with RISE Plug test method (applying a torque for twisting off a plug)
  - FTIR analysis of the foam of the retrieved plug to compare absorption indices representing the urethane bonds C=O and N-H
  - Calculated the time at a certain reference temperature, to quantify the usage of the pipe
  - Restore the pipe
- IPF & IMA: Thermogravimetric Analysis



Accelerated ageing tests

- Elevated temperature
  - 140°C (Proposed by RISE)
- Testing time
  - 0,5-1 year (Consequence of 140°C)
- Other environmental parameters
  - The effect of the shear load is further investigated by RISE in an ongoing project
  - Effect of oxygen diffusion through the casing

Lifetime estimations

- Models
  - Can an Arrhenius relationship be used ?
- Tests for determining the status
  - Field tests with eg RISE Plug test method
  - FTIR analysis of the foam at two positions of the retrieved plug
- Evaluations of status
  - Compare results of supply and return
  - Compare changes of FTIR spectra inflicted by changes of molecular structure

- RISE: Accelerated ageing and lifetime predictions – Standardization vs Research