Quality assessment of the PVC gas grid in the Netherlands

René Hermkens, 17 September 2019 Bologna

Kiwa Technology

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Quality
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Introduction

Total length natural gas distribution grid in the Netherlands ~125,000 km

- PVC ~81,000 km (64%)
  - PVC-U ~21,000 km (17%)
  - PVC-Hi ~60,000 km (47%)

- Installation of PVC
  - PVC-U installed from 1960 to 1974
  - PVC-Hi installed from 1974 till now

Assessment of the PVC-grid

Age PVC-U grid: > 45 years

Question: Is replacement necessary?

- Internal gas pressure: 30 or 100 mbar
  -> Strength not an issue

- Lifetime limiting failure mode PVC gas grid:
  - No slow crack growth observed
  - Main failure cause: third party damage
  -> Impact resistance most important

Impact resistance and failure modes

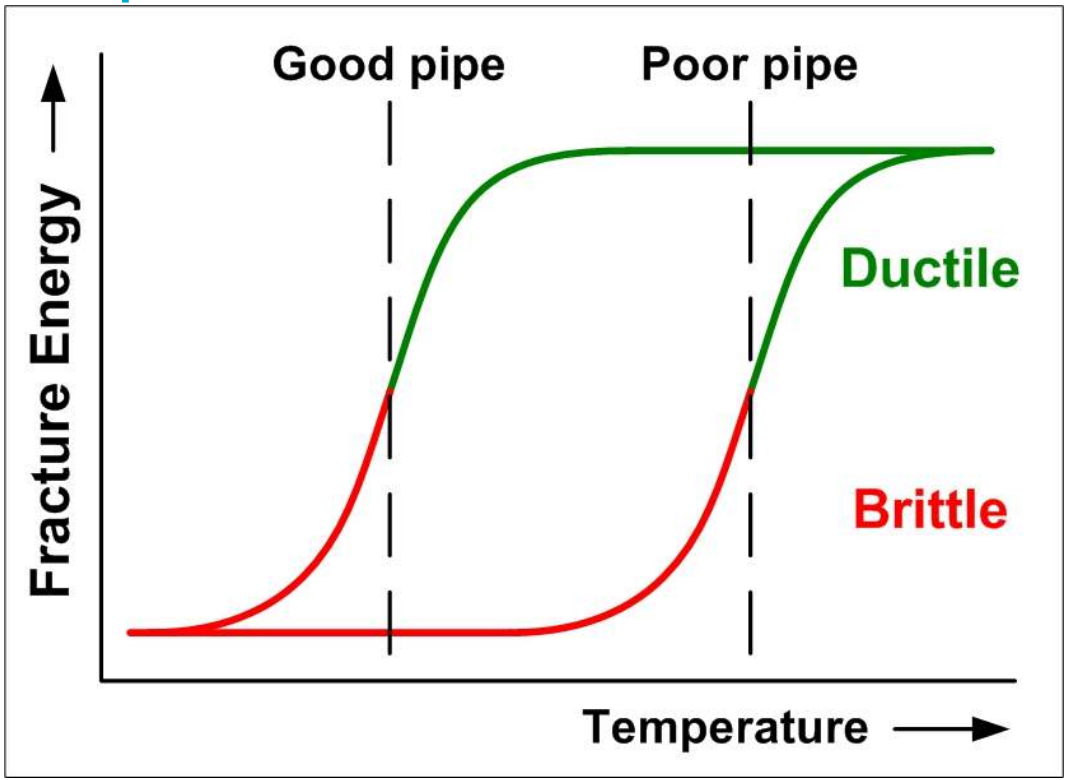
Brittle failure:

- High gas outflow
  - No time to detect and repair leak
  - High chance of explosion or fire
- Repair difficult (sawing)

Ductile failure:

- Limited to no gas outflow
  - Ability to detect and repair leak
  - Low chance of fire

Measuring impact resistance

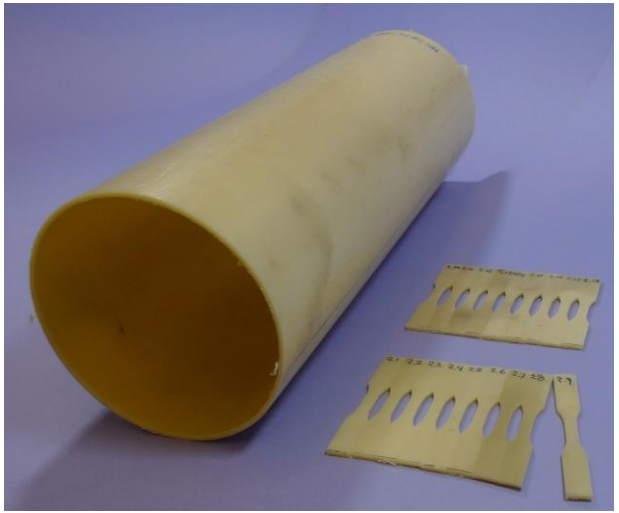


Brittle-ductile-transition-temperature (Tbd): 50% brittle, 50% ductile

Experimental setup

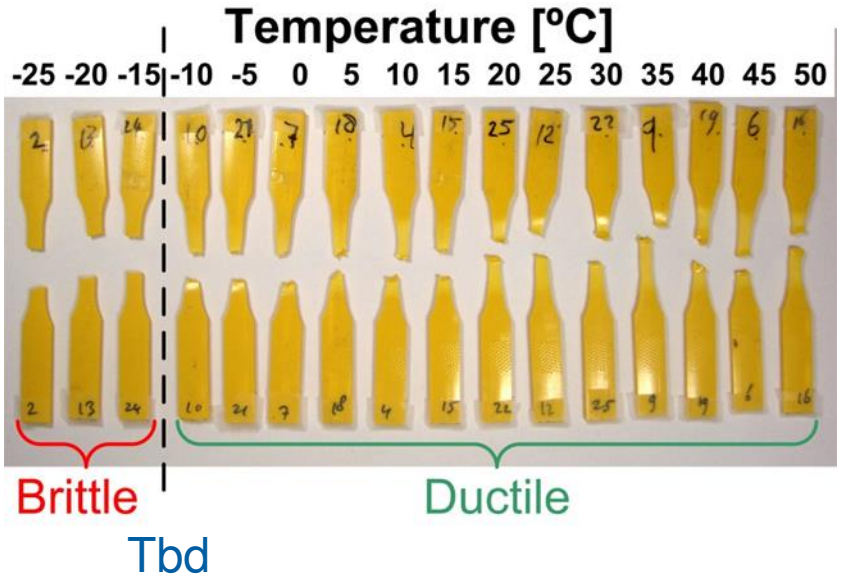
New test method developed:

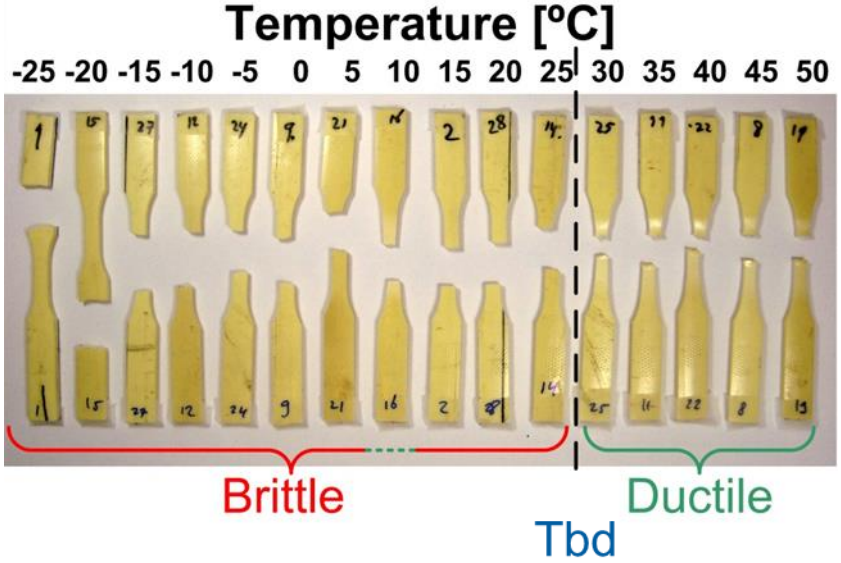
- Instrumented impact tester
- Modifications:
  - Temperature range: -25˚C to +47,5˚C
  - Random test bar selection from pipe
  - Optimization of the number of test bars and test bar shape: 30 test bars (Dumbbell shape)



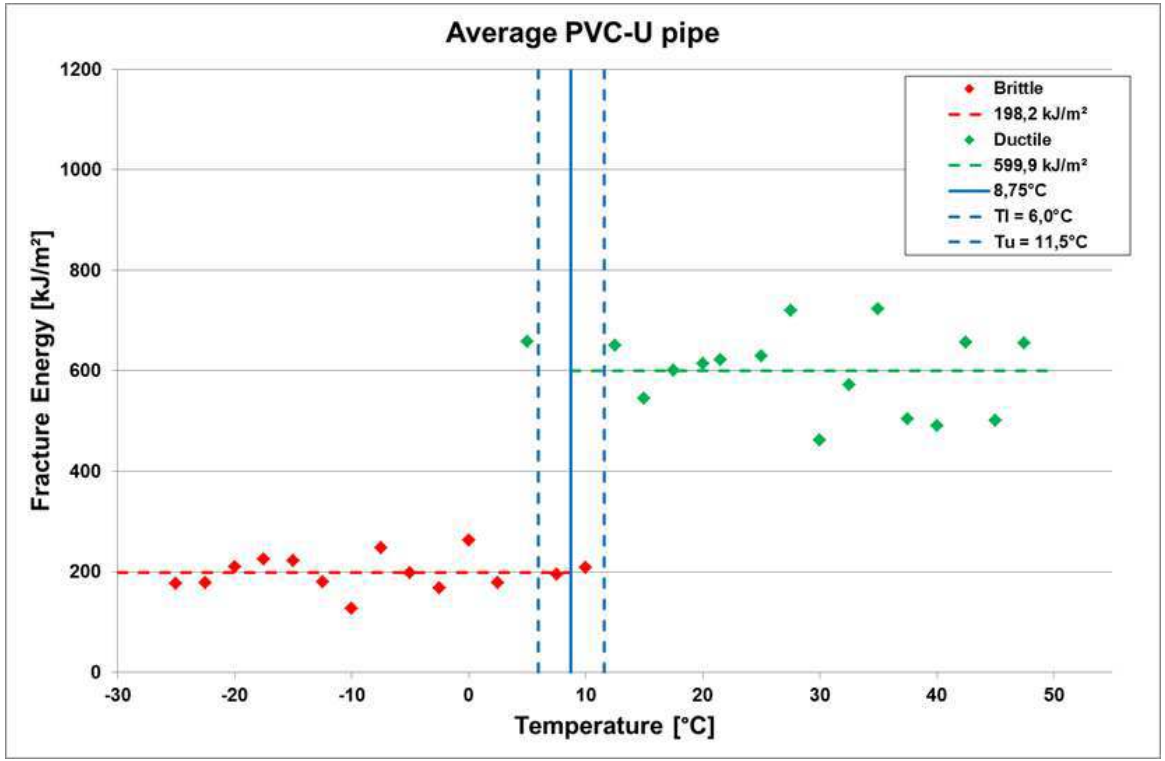
Measuring Tbd

Visual compare of good (left) and poor (right) quality PVC pipe





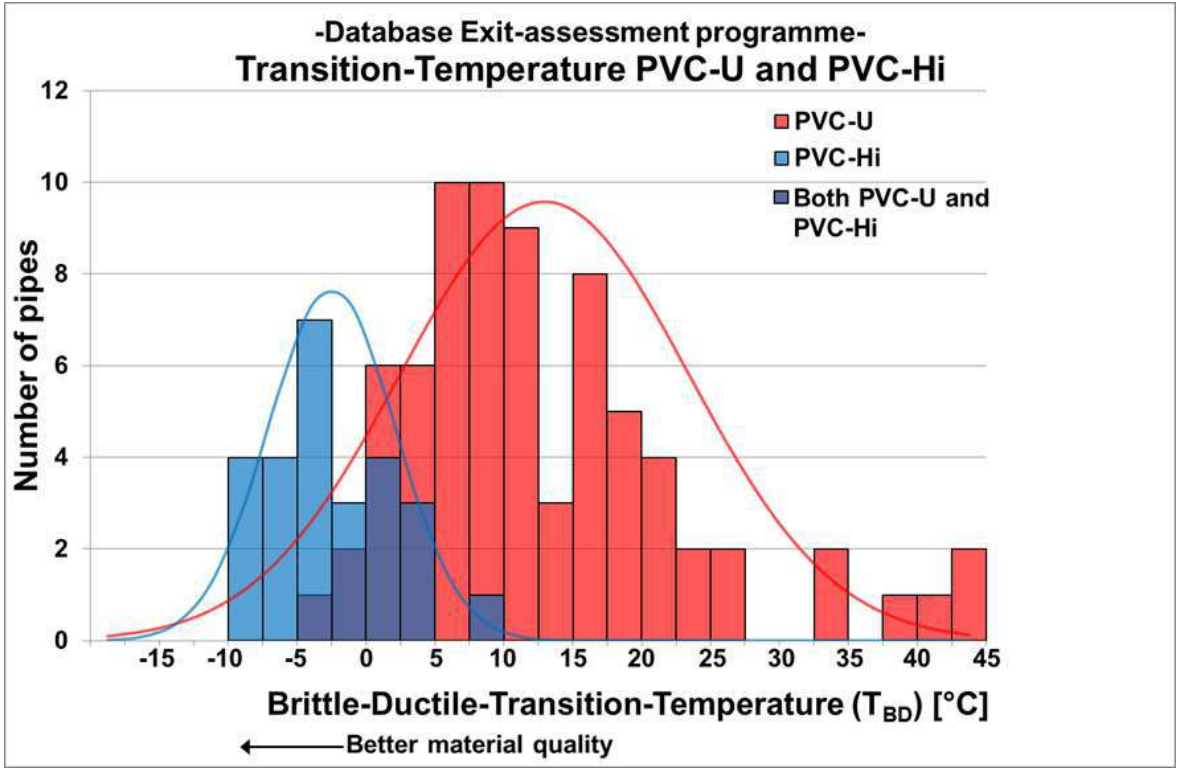
Measuring Tbd: results



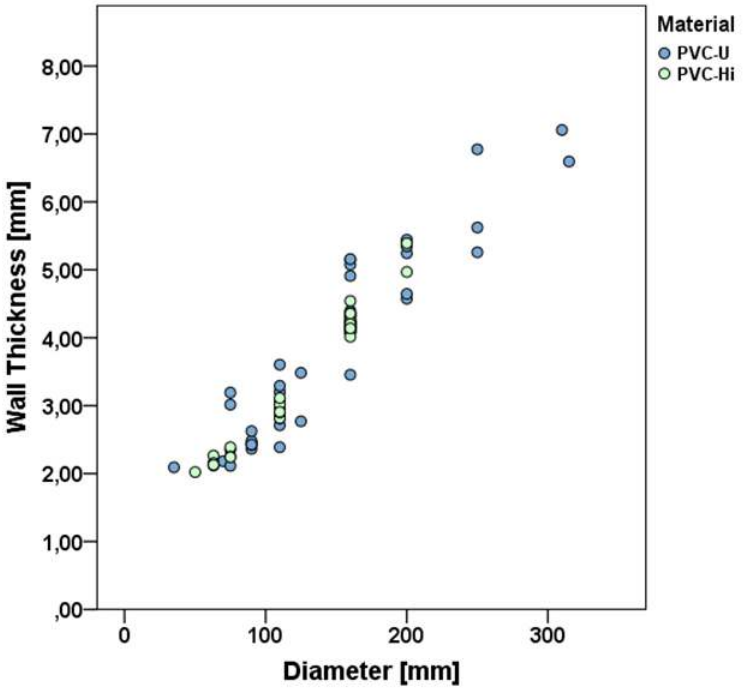
An average PVC-U pipe with a T_{BD} of 8,75°C

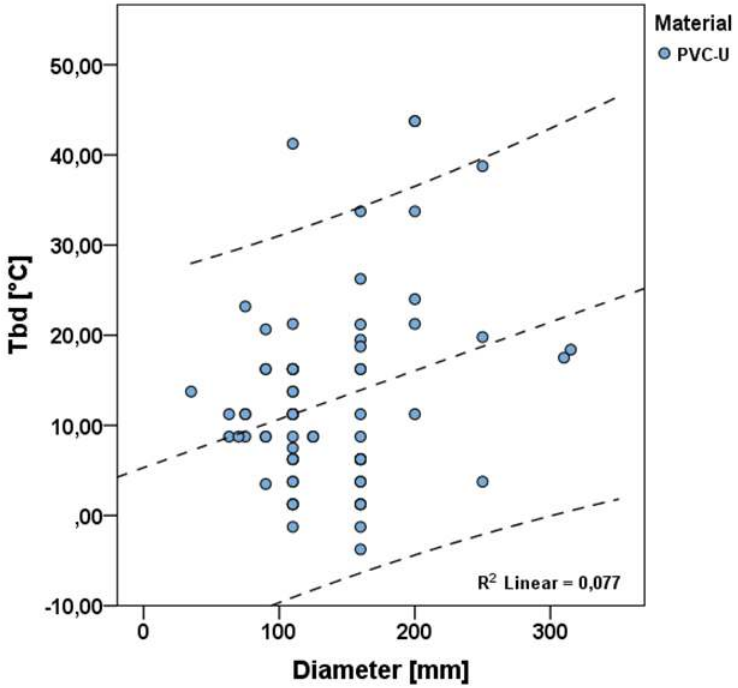
Results Exit assessment programme

- Annually 15 samples of both PVC-U and PVC-Hi
- Additional information from distribution system operator on:
  - Installation date
  - Dept of installation
  - Type of installation
  - Ground water level
  - Et.cetera



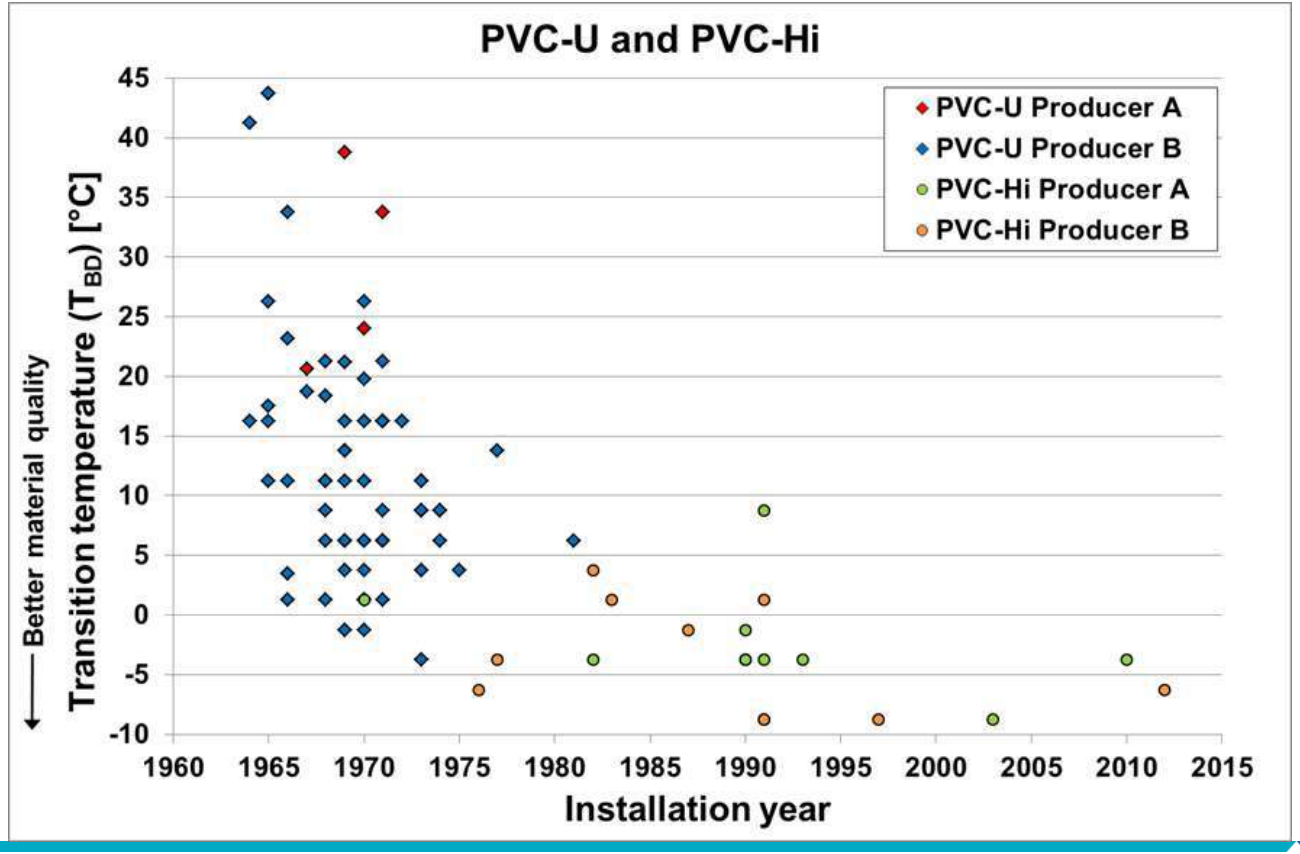
Effect of wall thickness on impact resistance





Trend between the brittle-ductile-transition-temperature (T_{BD}) and the diameter of old PVC-U pipes (right) and relation between wall thickness and diameter of the pipe (left).

Quality improvement over the years



Conclusions

- The improved impact test is able to distinguish sub populations of PVC pipes in the Dutch gas grid, based on material quality.
- The DSOs can use this information to optimize their replacement prioritization
- A larger diameter and therefore a thicker pipe wall seems to negatively influence the material quality of PVC-U by elevation the T_{BD}
- PVC pipes which are produced later in time have a better material quality


ANY
QUESTIONS?