

Quality assessment of the PVC gas grid in the Netherlands

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Kiwa Technology

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Quality
Progress**



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:

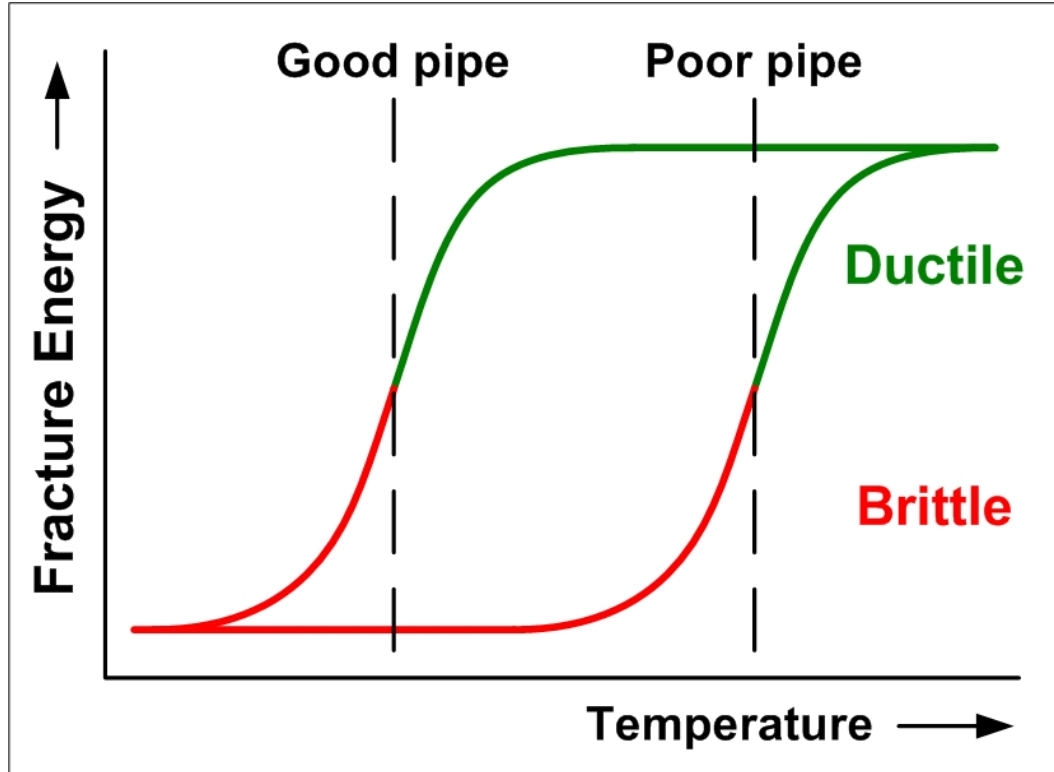
- High gas outflow
 - No time to detect and repair leak
 - High chance of explosion or fire
- Repair difficult (sawing)

Ductile failure:

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



Measuring impact resistance



Brittle-ductile-transition-temperature (T_{bd}): 50% brittle, 50% ductile

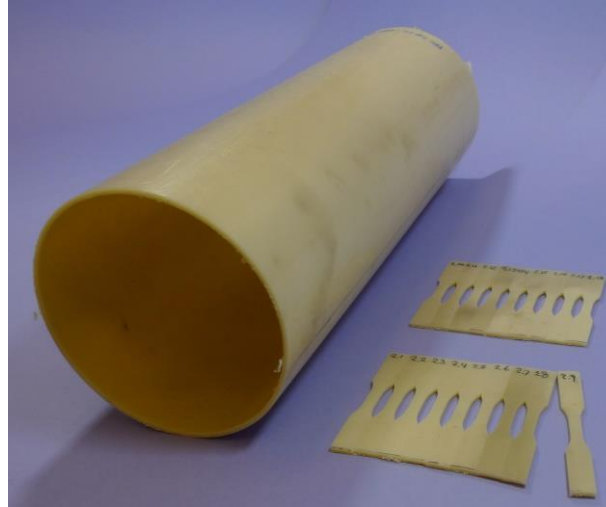
Experimental setup

New test method developed:

- Instrumented impact tester

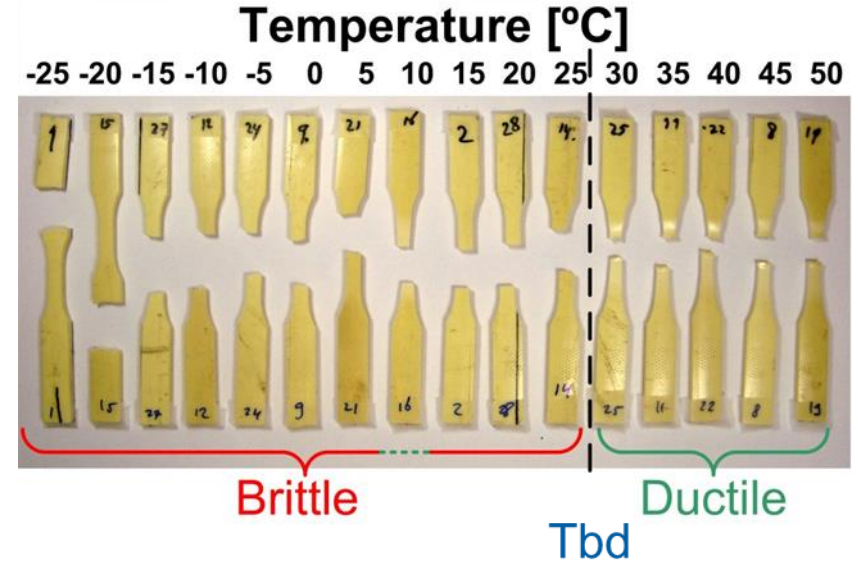
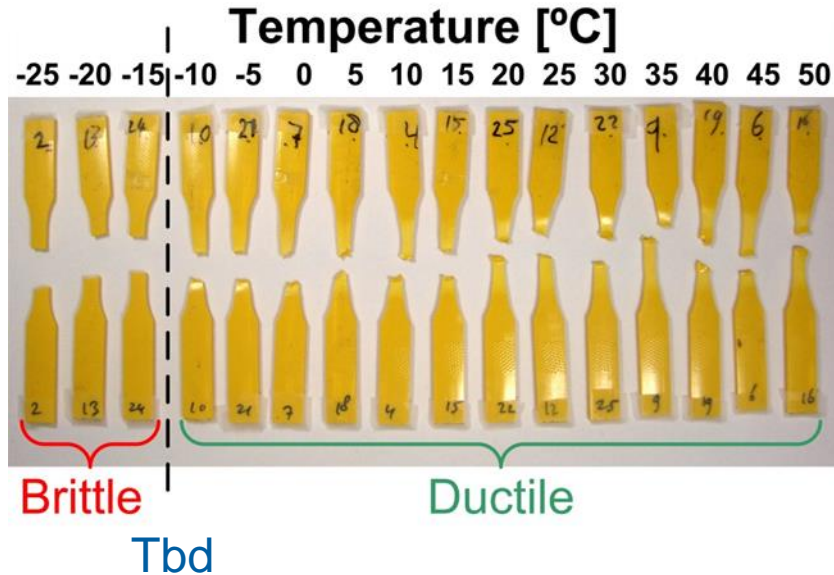
- Modifications:

- 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)

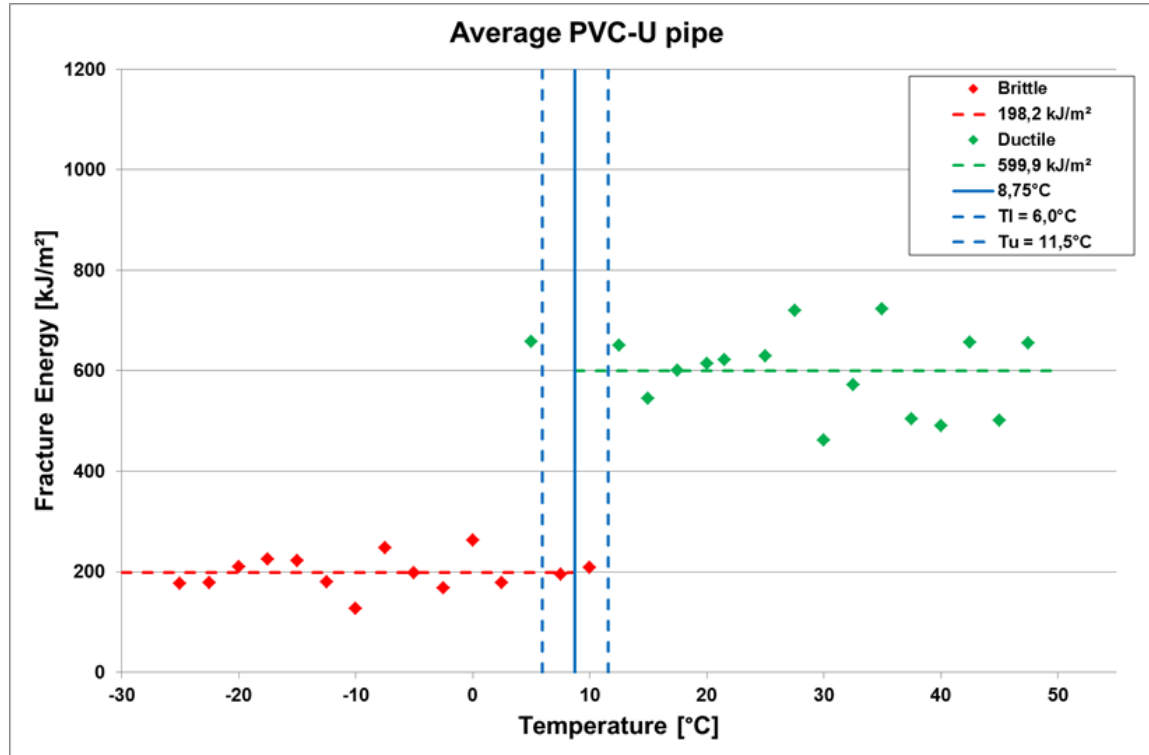


Measuring Tbd

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



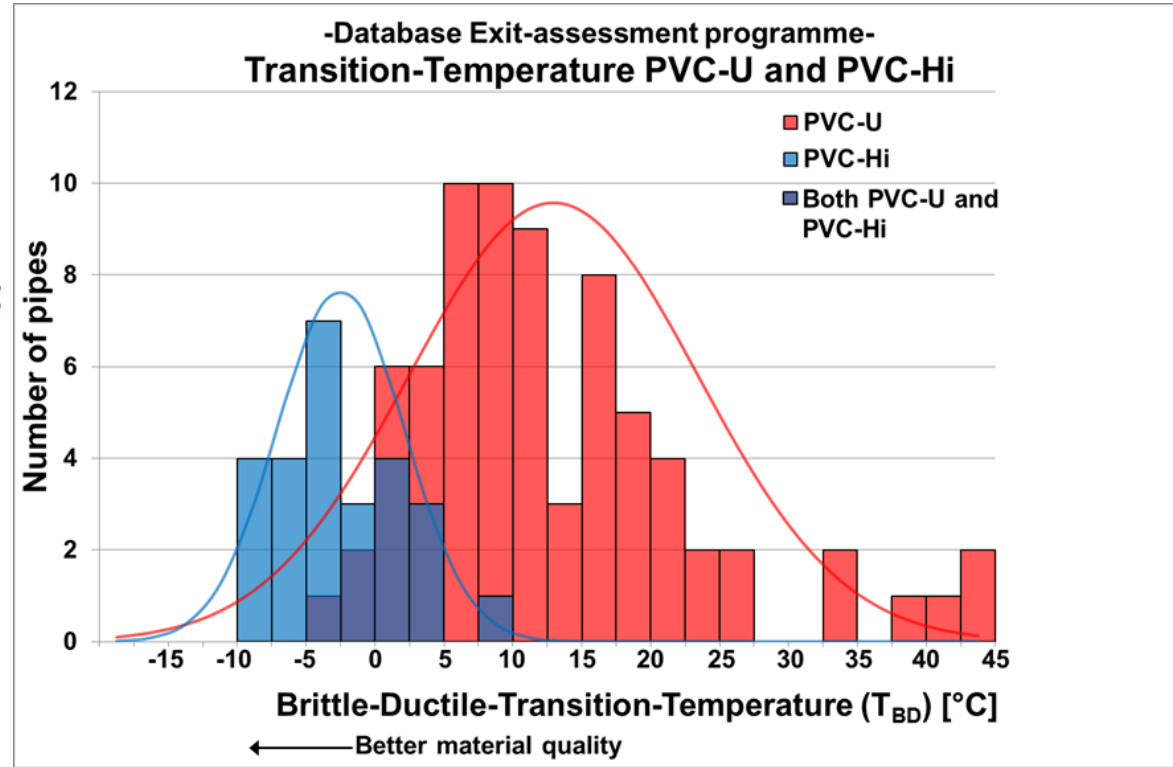
Measuring Tbd: results



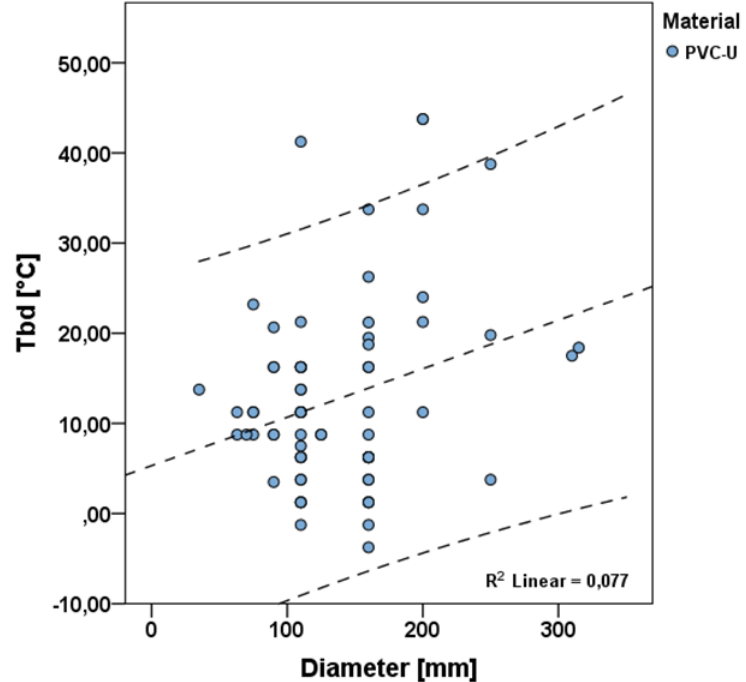
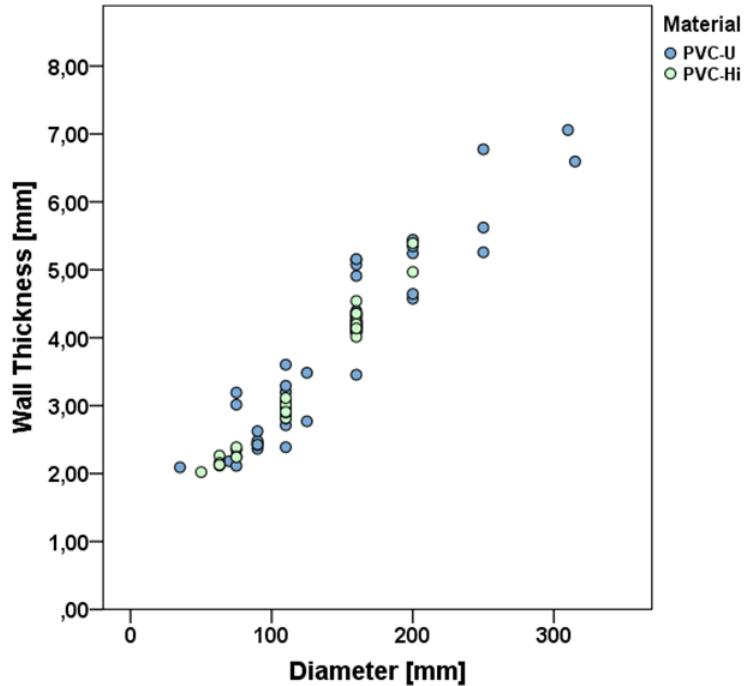
An average PVC-U pipe with a T_{BD} of 8,75°C

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

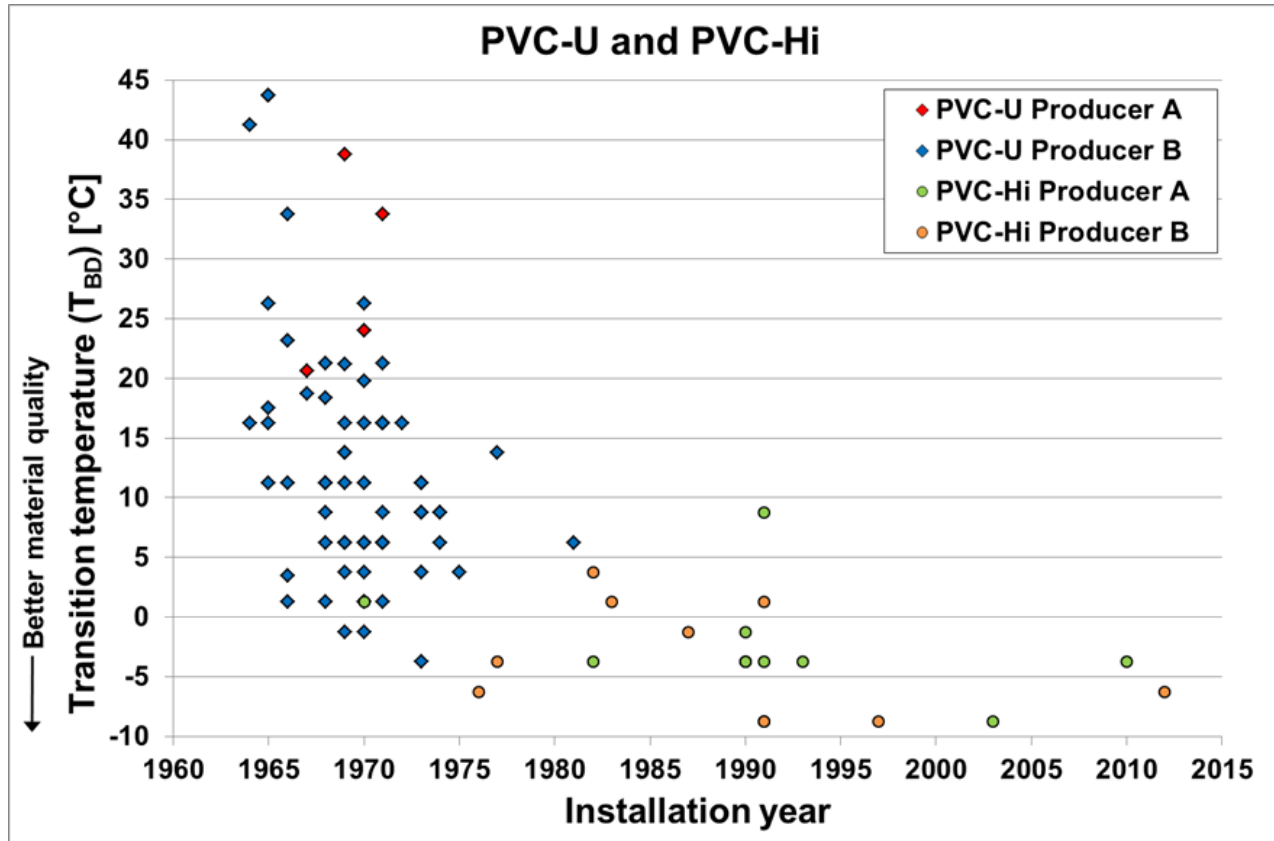


Effect of wall thickness on impact resistance



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?

