Defining Network efficiency

Jørgen Ægidius, VP Sales
EHP conference, Tallinn
April 2015
Defining network efficiency, contents

- Facts about LOGSTOR
- Reducing heat loss from distribution systems
- Fully diffusion tight pipesystems
- Product News
- FLEXTRA flexible pipesystems
- GH steel quality
- LOGSTOR Calculator
- LOGSTOR Value Proposition
The LOGSTOR Group & our global presence

- Headquarters in Denmark
- 1,500 employees
- Annual turnover > 250 MEUR
- Owner: Triton Fund III

- 8 plants in Europe, 1 in Asia, 2 mobile production units
- 14 Sales units
- Joint ventures in China and Dubai
- Distributors in more than 30 countries
- More than 5,000 km pre-insulated pipes every year
- More than 185,000 km LOGSTOR pipe supplied to date
1. Reducing heat loss
Facts about total Cost of Ownership (TCO)/ Lifetime costs

- Operating costs makes up for approx. 70% of the TCO for a DH distribution system
- Reduction of energy loss is the most effective way to reduce operating costs
- Energy savings can be achieved by
  - Insulation properties
  - Insulation wall thickness
  - Selection of pipe system
  - Protection of long time insulation properties

LOGSTOR focus: improvement of products energy efficiency.
Factors that influence heat loss from system

- The operating temperature of the circulating water in the pipes
- Ageing of PUR
- Production method, traditional vs. conti
- Selection of pipesystem, pair of pipes vs. Twin
- Insulation material properties
Heat loss for DN 50 pair of pipes / Twin - 30 years

<table>
<thead>
<tr>
<th>Option</th>
<th>Heat loss</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Series 1 without barrier</td>
<td>100% 42</td>
<td>0%</td>
</tr>
<tr>
<td>Traditional Series 2 without barrier</td>
<td>77% 33</td>
<td>23% 10</td>
</tr>
<tr>
<td>Traditional Series 2 with diff</td>
<td>84% 36</td>
<td>16% 7</td>
</tr>
<tr>
<td>Conti from LOGSTOR Series 1 with diff</td>
<td>42% 18</td>
<td>58% 24</td>
</tr>
<tr>
<td>Conti from TwinPipe S2 with diff</td>
<td>61% 26</td>
<td>39% 16</td>
</tr>
</tbody>
</table>

1000 m trench - DN 50 - Temp 110/80
• Fully diffusion tight systems
The diffusion barrier, new opportunity

- Diffusion barrier in pipes ≤ 315 mm casing has been an option in +10 years from LOGSTOR
- Joints and fittings makes up for a substantial part of the pipe length
- Hence the introduction of a fully diffusion tight system
- Diffusion barrier also in fittings and joints in casing < ø355 mm, will be available from 2H.2015

Opportunity for complete diffusion tight pipe systems
Diffusion barrier applications in brief

• Metal foil in axial conti production, rigid and flex

Foaming in moving mould/foil
form/ folie

Alu barrier Corona treated

Foil in spiral and semi conti production

EVOH barrier on PEX pipes

DH

O₂ - Oxygen
Diffusion barrier new applications
FLEXTRA, news product line:
• It is a 5-layer co-extruded casing, having the EVOH barrier in the middle of the casing
• LDPE/adhesive/EVOH/adhesive/LDPE
• Dimension range ø90 – ø180 mm

Traditional extruded 3-layer HDPE with EVOH barrier:
• Application for prefabricated fittings and joints
• The EVOH barrier is 0,2 – 0,3 mm thick
• Welding of PE is possible by removing the EVOH layer
• 3-layer casing pipes with EVOH are available in the dimension range from ø90 to ø355
• EVOH stands for Ethylene Vinyl Alcohol
• LOGSTOR has more than 15 years’ experience with EVOH barrier in district heating pipes
• EVOH is used on PEX pipes as a diffusion barrier to prevent diffusion of oxygen into the district heating water.
• EVOH can be considered to be a 100 % diffusion-tight material against oxygen, nitrogen, and cyclopentane diffusion

<table>
<thead>
<tr>
<th></th>
<th>O₂</th>
<th>N₂</th>
<th>CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE-LD</td>
<td>240</td>
<td>62</td>
<td>840</td>
</tr>
<tr>
<td>PE-HD (2% CB)</td>
<td>70</td>
<td>22</td>
<td>247</td>
</tr>
<tr>
<td>EVOH</td>
<td>0,025</td>
<td>0,0026</td>
<td>0,14</td>
</tr>
</tbody>
</table>
# Documentation of EVOH barrier properties

## Thermal conductivity test of FLEXTRA pipe before and after ageing (70°C and 13 weeks) performed by IMA

### New, foamed pipe

![Image of a pipe with a red arrow indicating the flow direction.](image)

- **Heat flow-rate $\phi$ [W]**
  - 16.99
  - 18.09
  - 19.03

- **Temperature at hot sample surface $T_1$ [°C]**
  - 71.02
  - 73.67
  - 76.47

- **Temperature at cold sample surface $T_4$ [°C]**
  - 25.15
  - 25.56
  - 26.17

- **Difference in temperature $T_1 - T_4$ [K]**
  - 45.88
  - 48.11
  - 50.30

- **Mean temperature of sample $T_m$ [°C]**
  - 47.79
  - 49.30
  - 50.99

- **Thermal conductivity of PUR-foam $\lambda_{PUR}$ [W/(m·K)]**
  - 0.0227
  - 0.0229
  - 0.0231

$$\lambda_{50} = 0.0230 \text{ W/(m·K)}$$

### Aged pipe

![Image of an aged pipe.](image)

- **Heat flow-rate $\phi$ [W]**
  - 17.02
  - 17.47
  - 17.99

- **Temperature at hot sample surface $T_1$ [°C]**
  - 73.40
  - 74.74
  - 76.04

- **Temperature at cold sample surface $T_4$ [°C]**
  - 24.93
  - 25.20
  - 25.40

- **Difference in temperature $T_1 - T_4$ [K]**
  - 48.47
  - 49.54
  - 50.64

- **Mean temperature of sample $T_m$ [°C]**
  - 48.87
  - 49.67
  - 50.41

- **Thermal conductivity of PUR-foam $\lambda_{PUR}$ [W/(m·K)]**
  - 0.0226
  - 0.0227
  - 0.0229

$$\lambda_{50} = 0.0228 \text{ W/(m·K)}$$
## Dimension range

- **Single pipes**

  Cover all casing pipe diameters up to Ø355

<table>
<thead>
<tr>
<th>DIFFUSION BARRIER SINGLE PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2500</td>
</tr>
<tr>
<td>S1</td>
</tr>
</tbody>
</table>

- **Pipe diameters**
  - DN20
  - DN25
  - DN32
  - DN40
  - DN50
  - DN65
  - DN80
  - DN100
  - DN125
  - DN150
  - DN200

- **Possible** - Green
- **Not possible** - Red

![Diagram of diffusion barrier single pipe configurations](image-url)
**Dimension range**

- **TwinPipes** Cover all casing pipe diameters up to Ø355

<table>
<thead>
<tr>
<th></th>
<th>2590</th>
<th>2591</th>
<th>2592</th>
<th>3071*</th>
<th>3072*</th>
<th>3490</th>
<th>3790</th>
<th>4290</th>
<th>4291</th>
<th>4292</th>
<th>4295*</th>
<th>4990</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 S2 S3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **possible**
- **not possible**

---

[Logstor logo] Defining network efficiency
Diffusion tight Joint, to complete the solution

• Joint is made of an extruded 3-layer casing pipe with an EVOH barrier inside
• To ensure a proper sealing, the EVOH layer will be removed at the end of the shrinking joint 90 – 110 mm
• The welding zone on weldable EWJoint is also without EVOH barrier

EWJoint with EVOH

Shrink joint with EVOH

Welding plug itself is not diffusion-tight, however due to wall thickness it can be considered to be tight
Example: Savings with diffusion tight distribution network

Prefabricated fittings and joints makes up for a substantial part of the length of a distribution network, dependent of design and dimensions in the range of 5 – 25%

<table>
<thead>
<tr>
<th>Element</th>
<th>Frequency</th>
<th>Length/item</th>
<th>Items per 1000 m trench</th>
<th>Total length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joints</td>
<td>6 m</td>
<td>0,44 m</td>
<td>333 pcs</td>
<td>147 m</td>
</tr>
<tr>
<td>Bends</td>
<td>25 m</td>
<td>1,56 m</td>
<td>80 pcs</td>
<td>125 m</td>
</tr>
<tr>
<td>Branches</td>
<td>40 m</td>
<td>2,4 m</td>
<td>50 pcs</td>
<td>120 m</td>
</tr>
<tr>
<td>Valves w/vent</td>
<td>250 m</td>
<td>2,0 m</td>
<td>8 pcs</td>
<td>16 m</td>
</tr>
<tr>
<td>Total length of fittings and joints in 1000 meter trench</td>
<td></td>
<td></td>
<td>20%</td>
<td>408 m</td>
</tr>
</tbody>
</table>
Savings by having an EVOH barrier in joints and fittings

- Project example calculated on basis of average dimension of dn50 in single pipes in insulation series 1
- Diffusion barrier brings considerable savings in energy loss and GHG emissions
- Additional savings in energy loss in fully diffusion tight pipesystems

DN 50 series 1, temperatures winter/summer: 80/48°C-70/45°C, fuel: coal
Product news:
FLEXTRA pipesystems
LOGSTOR FlextraPipe

- The markets most flexible pipe
- PEX, CU and AluPex pipes
- Now available in ø180 casing
Bending test in accordance with EN requirements without any cracks in PUR foam
## Test Certificate – Lambda PUR FlextraPipe

### Unaged

<table>
<thead>
<tr>
<th>Heat flow-rate $\phi$ [W]</th>
<th>Temperature</th>
<th>Difference in temperature</th>
<th>Mean temperature of sample $T_m$ [°C]</th>
<th>Thermal conductivity of PUR-foam $\lambda_{PUR}$ [W/(m·K)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hot sample surface</td>
<td>cold surface</td>
<td>$T_1 - T_4$ [K]</td>
<td></td>
</tr>
<tr>
<td>16,99</td>
<td>71,02</td>
<td>25,15</td>
<td>45,88</td>
<td>47,79</td>
</tr>
<tr>
<td>18,09</td>
<td>73,67</td>
<td>25,56</td>
<td>48,11</td>
<td>49,30</td>
</tr>
<tr>
<td>19,03</td>
<td>76,47</td>
<td>26,17</td>
<td>50,30</td>
<td>50,99</td>
</tr>
</tbody>
</table>

$\lambda_{50} = 0,0230$ W/(m·K)

### Improved lambda value to be introduced in 2015

### Aged, 70°C, 100 days

<table>
<thead>
<tr>
<th>Heat flow-rate $\phi$ [W]</th>
<th>Temperature</th>
<th>Difference in temperature</th>
<th>Mean temperature of sample $T_m$ [°C]</th>
<th>Thermal conductivity of PUR-foam $\lambda_{PUR}$ [W/(m·K)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hot sample surface</td>
<td>cold surface</td>
<td>$T_1 - T_4$ [K]</td>
<td></td>
</tr>
<tr>
<td>17,02</td>
<td>73,40</td>
<td>24,93</td>
<td>48,47</td>
<td>48,87</td>
</tr>
<tr>
<td>17,47</td>
<td>74,74</td>
<td>25,20</td>
<td>49,54</td>
<td>49,97</td>
</tr>
<tr>
<td>17,99</td>
<td>76,04</td>
<td>25,40</td>
<td>50,84</td>
<td>50,41</td>
</tr>
</tbody>
</table>

$\lambda_{50} = 0,0228$ W/(m·K)
• Product news
• GH steelquality
Future requirements to steel pipes, EN253 +A2

• Amendment A2 to EN253, only allowing use of P235GH will be published by year end 2015 to be fully implemented before end of 2016
• LOGSTOR have decided to implement this change as a standard as per 01.03.2015
• Benefits related to this are:

  • To ensure well defined material properties and the +30 year lifetime of the pipe system
  • Yield strength test at elevated temperature > 50° is done.
  • Impact test is done
  • Normalized pipe material is used and weld seam is annealed, or whole pipe is annealed.
  • Defined Aluminum content can ensure proper welding conditions

• No consequences on price
• Always GH quality in stock
• LOGSTOR Calculator
New platform for LOGSTOR Calculator

LOGSTOR Calculator can be used on all platforms, PC, Apple & Android. New functions, additional to previous:

- Calculation with free lambda value
- Calculation of temperature drop
- Calculation of ROI

Introduced in April 2015
LOGSTOR Value Proposition: providing value to our customers

Lowest total cost of operation
- Insulation Technologies
- Lifetime Insulation protection
- Integrated Solutions

Effective installation
- LOGSTOR Joints
- LOGSTOR Design Services
- Documentation & Certification

Longest life time
- Surveillance
- LOGSTOR Calculator
- LOGSTOR Services

Customer Excellence
- Responsiveness
- Transport & Delivery Accuracy
- Accountability
Thank you for your attention

jani@logstor.com
jull@logstor.com
tiit@tlr.ee
www.logstor.com