

Alternative Pipeline Materials

Matthew Guite

IBC

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Introduction

- This covers pipeline materials other than steel.**
- The aim of this section is to give an overview of these materials and the key issues to be addressed when using them.**
- It does not provide a comprehensive market review and new vendors and materials are appearing regularly.**

Introduction

- **Why choose an alternative material?**
- **Two aspects dominate the reasons for choosing such systems**
- **Corrosion resistance**
- **Speed of installation**
- **Commonly used for water transport / injection and gas systems.**
- **They are NOT METAL. DO NOT USE METAL DESIGN SYSTEMS**

Available alternatives

Alternative materials

- **Poly Ethylene (PE)**
- **Glass Reinforced Epoxy (GRE / fibre glass)**
- **Fibre Reinforced Plastic (FRP)**
- **Reinforced Thermoplastic (RTP)**
- **Liners**

Poly Ethylene (PE)

- **PE is widely used in low pressure (<16bar) water and gas distribution systems**
- **Two common grades - PE 80 & PE100. Previously called MDPE and HDPE**
- **Mature specifications and codes – ISO 4427 parts 1 to 3 provides key data and requirements**
- **Pipeline is defined in METRIC OD, not imperial units.**
- **Thickness is determined by “SDR” – Size Dimension Ratio – D/t**

Poly Ethylene

- **SDR 11 is thickest / highest pressure**
- **Max pressure rating for 50 years is at 20C, derates to min factor of 0.4 at 50C**
- **Very good for corrosion issues.**
- **Slurry and particulate pipelines have excellent properties.**
- **UHMW pipelines now available for higher strength and higher abrasion resistance.**
- **Jointing by fusion or use of couplings**
- **Reeling up to 180mmOD**

Poly Ethylene fusion jointing – butt weld



Poly Ethylene fusion jointing – electrofusion coupling



Poly Ethylene

Issues:

- **Vacuum collapse strength is poor**
- **Maximum Pressure rating limited to 16 barg (PE100, SDR 11)**
- **Long term temperature de-rating starts at 20C, max 50C (0.4 derating)**
- **Permeable to hydrocarbons (sweats)**
- **Fire rating low**
- **UV protection required for A/G sections (black PE)**
- **Thermal expansion (X 10 compared to steel)**
- **Creeps under constant stress. Hydro test requires decay curve.**

Glass Reinforced Epoxy (GRE)

- **Commonly referred to as “Fibre Glass”**
- **Used for chemicals and corrosive water systems**
- **ISO 14692 parts 1 to 4**
- **Vendor specific manufacture and sizing**
- **Higher pressure rating than PE**
- **High Poissons effect reduces expansion impact – normally in tension when under pressure.**
- **Can be stress analysed in Caesar (vendor properties required)**

Glass Reinforced Epoxy (GRE)

**High pressure rating at
low sizes**

50 bar rating at 12"

**Steel reinforced pipe is
available to increase
pressure ratings**

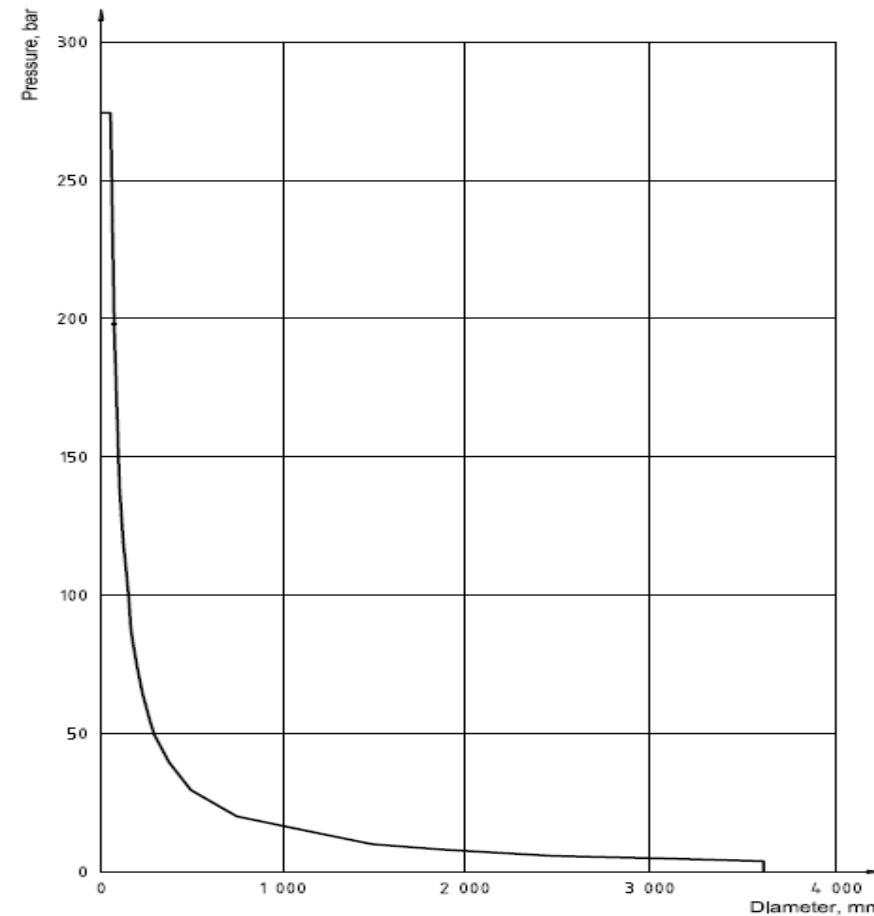


Figure 1 — Envelope of pressure/diameter range of GRP pipes and piping systems based on current experience

Glass Reinforced Epoxy (GRE)

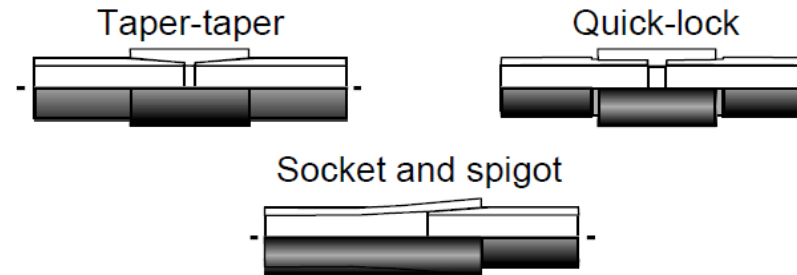
**Joining techniques
commonly used**

**Threaded joints are often
also glued and sometimes
also overwrapped**

**NDE of the joint is not
possible – await hydrotest.**

**Glued joints need setting
time – low productivity**

Adhesively bonded joints

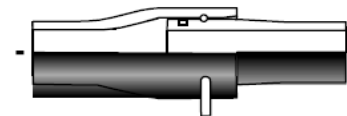


Laminated ('Butt and wrap') joint

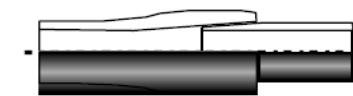


Mechanical joints

Rubber seal or Key-Lock



Threaded



Glass Reinforced Epoxy (GRE)

Issues:

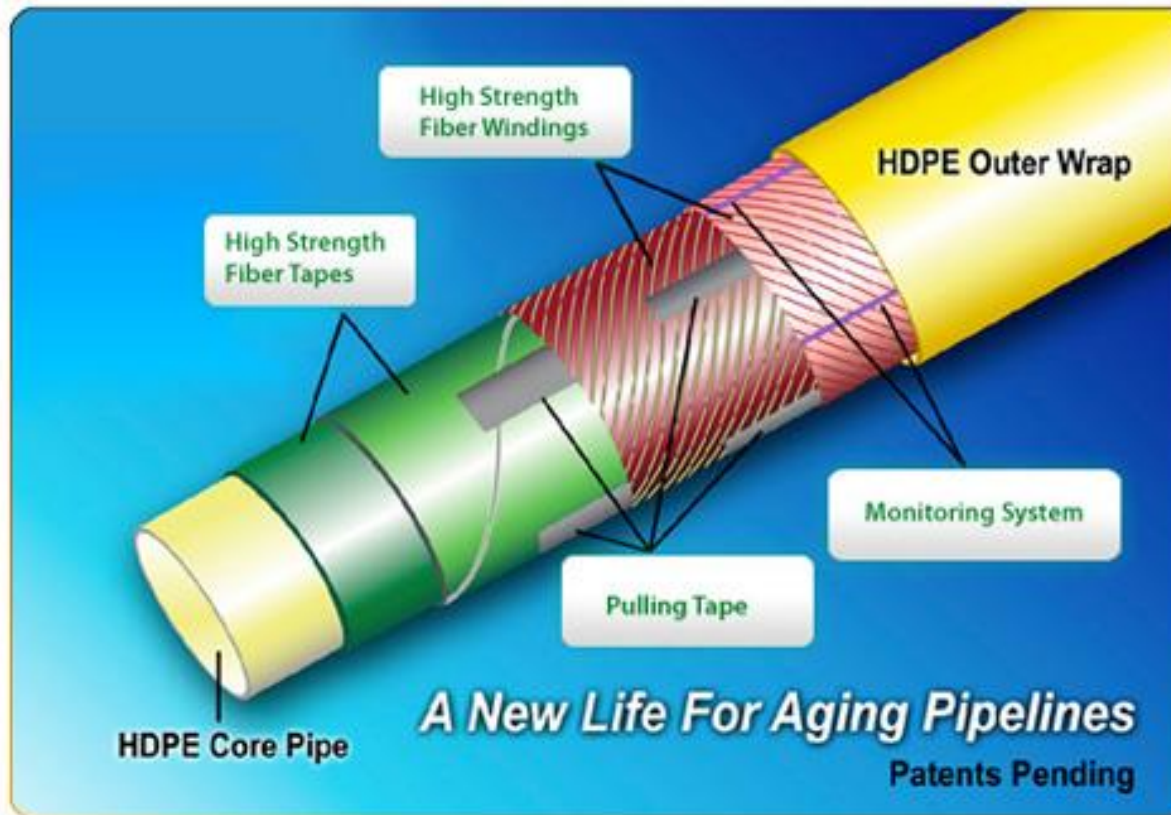
- **Can be damaged without showing external signs (bruising)**
- **Cannot be flexibly bent**
- **Abrasion in buried lines can be significant**
- **Formed elbows required for all bends**
- **Aging in UV can be an issue**

Fibre Reinforced Plastic (FRP / RTP)

FRP pipe is supplied by a number of vendors with the following main properties:

- **Inner liner of PE or similar plastic**
- **Multiple bands of fibre (aramid / carbon fibre) laid in alternating weaves with further material.**
- **Generally in the 4-6” range up to 200+ barg**
- **Reeled applications**
- **Conforms to API 17J – performance based flexible spec for unbonded flexible pipe.**

Fibre Reinforced Plastic (FRP / RTP)



Fibre Reinforced Plastic (FRP / RTP)

Issues:

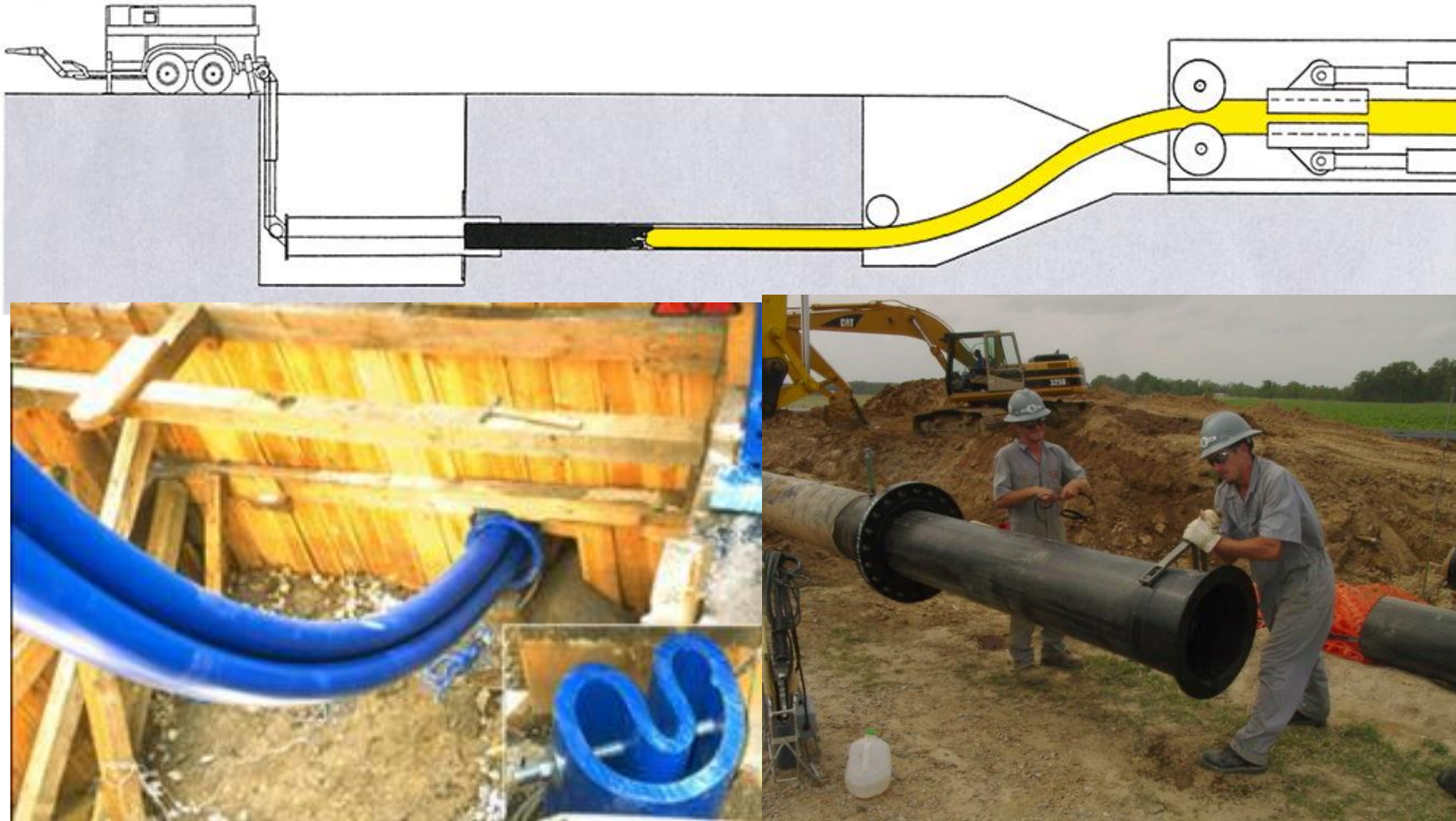
- **Limited size range (max 8")**
- **Low external pressure collapse**
- **Fittings and joints require special machines / fittings**
- **Can still leach hydrocarbons / gas through liners**
- **Leaks can exhibit a long way from internal leak**
- **Not able to be inspected internally**

Liners

- **Predominantly PE liners inside steel pipelines**
- **Swage lining uses reduced diameter – capable of 1000m + for straight pipe**
- **U jointing can increase distances**
- **Jointing / Flanges causes issues**
- **Lower friction can increase capacity for reduced ID**
- **Gas breakthrough requires grooved pipe and vents**

Liners

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Liners

Issues:

- **Limited in length (max 1000m)**
- **Restricts / prevent further inspection of steel outer pipe**
- **Internal leaks or gouges can result in continued corrosion**
- **Connections become blocked**
- **Can collapse due to gas permeation**

Summary

- **Alternatives exist for metal pipe**
- **PE / GRE / FRP/TRP, lined pipe**
- **Vendor dependant**
- **Water / gas predominantly**
- **They are not METAL**

The background of the slide is an abstract, swirling pattern in shades of blue and black, resembling a vortex or a stylized eye. The text is positioned on the left side of the image.

Thank You

Any questions?