

PE100 Pipes – Bimodal Innovation of Pressure Pipe Applications

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Abstract

The use of polyethylene as a pipe material had to overcome challenges to commonly used pipe material (mostly iron and steel). Pipes made from iron and steel are relatively expensive and are susceptible to degradation by corrosion. In addition these pipes require elaborate systems for installation, corrosion protection and maintenance. Higher performance in terms of physical properties and processability were achieved after developing Bimodal High Density PE technology.

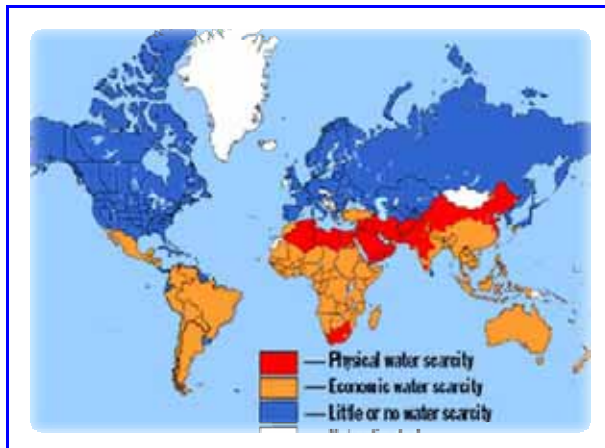
After long, proven track record of using Bimodal HDPE pipe in water and gas distribution network, PE100 pressure pipes introduced to the market which has broadened the range of pipe applications even further. PE 100 pipe sets new standards in three fundamental properties:

1. Resistance to rapid Crack propagation
2. Creep rupture Strength
3. Stress crack resistance

PE100 Pipes has become the material of choice in many of the developed areas of the world, based on its inherent advantages over other materials.

SABIC contributing to pipe business in forming Plastic Pipe Academy (GPPA) with clear vision of Engaging its members in information sharing, standardisation and certification efforts, Providing education and training on the design, construction and installation of plastics pipe systems and advising on ecological issues and Promoting innovative new plastics pipe system approaches Water –a worldwide issue

[Note: This work is formatted as received from the author.](#)



People around the world face water shortages

- Including 17 countries in the Middle East and North Africa regions
- KSA one of major affected country
 - High consumption (>300 l/day/head v.s 200)
 - High level of Water lose (>30%)
- Tackling the challenges of ensuring security of global water supplies
- Plastics help to create more sophisticated piping systems
- Standardisation helping to protect consumers with consistency and quality, safety, health and environment

Challenges of the future

Secure supply			
			
Energy/gas	Clean drinking water		Discharging waste water

Pipe Network Current situation in KSA



- ❑ High leakage rates and maintenance cost for traditional pipes which can be virtually eliminated with high quality plastics pipe systems. In KSA, leak rate vary from 15% to 30% of water pipe neworke resulting of billions \$ lose.
- ❑ The main challenges for Plastic Pipe systems are:
 - Lack of local safe guards and knowledge makes it difficult to distinguish between poor and high quality plastics pipe systems
 - Poor quality pipe systems have created problems for end users and is a threat to the reputation of plastics pipes in the future

The lack of standards and certification schemes and implementations makes introduction of better pipes difficult

SABIC Contribution to solve

Targeting to have high Quality Piping System in KSA

- Supply High Quality & Proven Product for Pipe System
- Education & Awareness
- Participate in Quality Control for Plastic Pipe



To achieve the Goal, Require good Coordination and Cooperation

Transportation means



Requirements for pipes and pipe compounds

Pressure Pipes are exposed to:

- ▶ Hydraulic pressure
- ▶ Mechanical loads (earth + traffic)
- ▶ Scratches during installation
- ▶ Attack of transported medium


Finally,

- ▶ Easy to be installed (economic!)
- ▶ Render leaktight pipe networks


Specific requirements

- ▶ Hydrostatic strength/Resistance to hydraulic pressure
- ▶ Resistance to Slow crack growth
- ▶ Resistance to Rapid Crack propagation
- ▶ Resistance to weathering
- ▶ Resistance to gas condensates
- ▶ Effect on drinking water quality

Solutions




(Source: zsb Germany)




(Source: egeplast GmbH/Germany)

Utility pipes out of bimodal Polyethylene



(Source: zsb Germany)



(Source: egeplast GmbH/Germany)

Resistance to hydraulic pressure

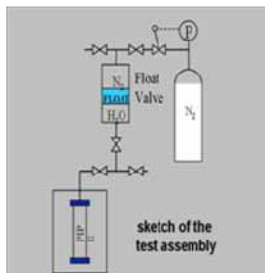
Creep rupture test

- Pipes filled with water
- Subjected to internal pressure
- Different
 - temperatures
 - stress levels



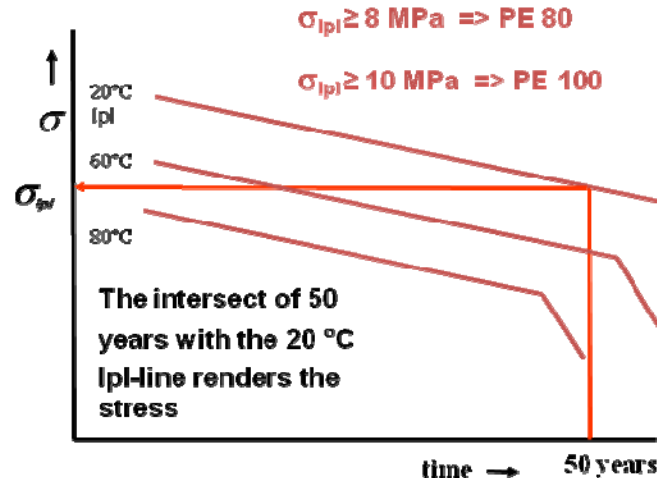
Result

- Time to failure



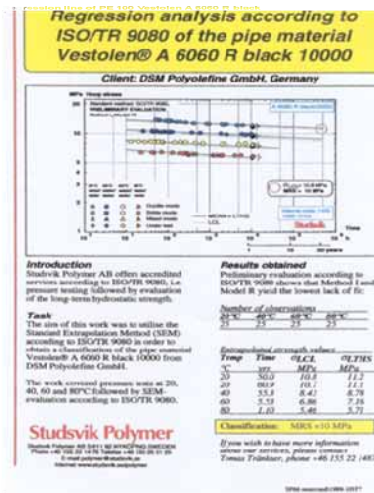
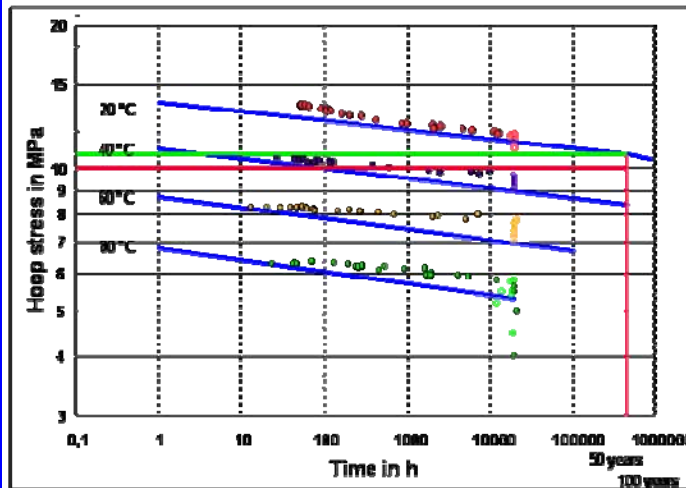
Hydrostatic strength

- Needed for lifetime assessment
- Needed for evaluation of desIn stress
- Entails pipe dimensions



Hydrostatic strength

Regression line of PE 100 Vestolen A 6060 R black



Pressure differences

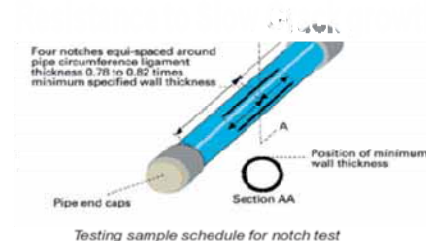
Pressure differences

Gas	SDR 11	SDR 17	SDR 17.6
PE 80	PN 4	PN 1	PN 1
PE 100	PN 10	PN 4	

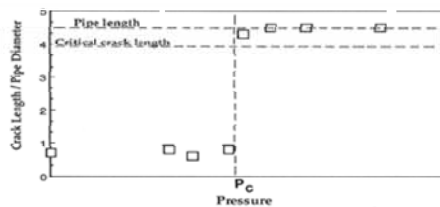
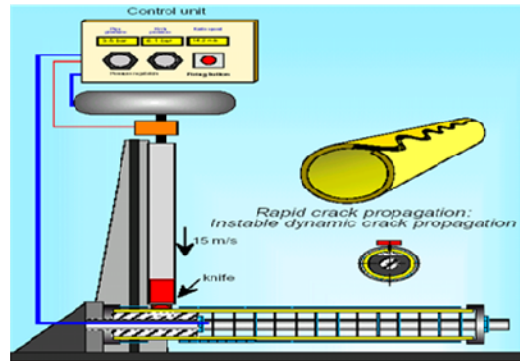
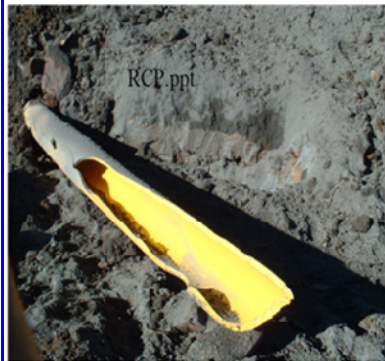
- Same SDR but larger PN

Resistance to Slow Crack growth

- Pipe are pulled from trucks and over the ground causing scratches and scores
- Test simulates the insertion of scores
- 4 longitudinal notches equidistantly
- around the circumference
- remaining ligament 80 % of nominal pipe wall
- Requirement 500 h minum failure time at 80 °C



Resistance to Rapid Crack Propagation S4 test

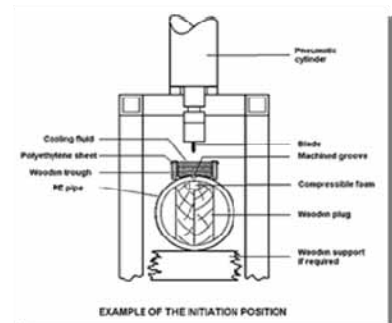


Requirement:

PE 80: 8 bars at 0 °C

PE 100: 10 bars at 0 °C

Resistance to Rapid Crack Propagation Full Scale test

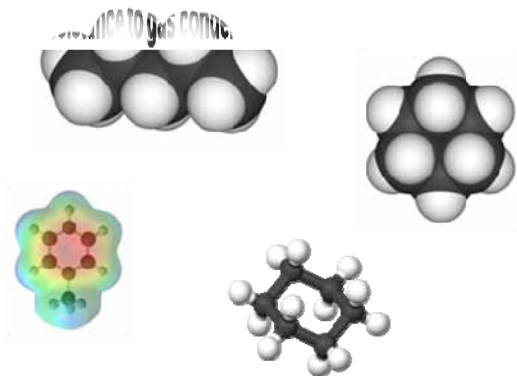


Requirement:

PE 80: 20 bars at 0 °C

PE 100: 24 bars at 0 °C

Resistance to gas condensates



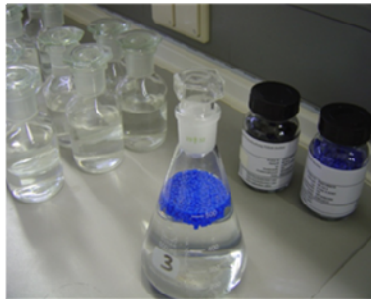
Requirement:

- Conditioning in synthetic gas condensate for 1500 h
- Pressure test at 80 °C - 2 MPa > 20 h



Source: Ipt

Effect on drinking water



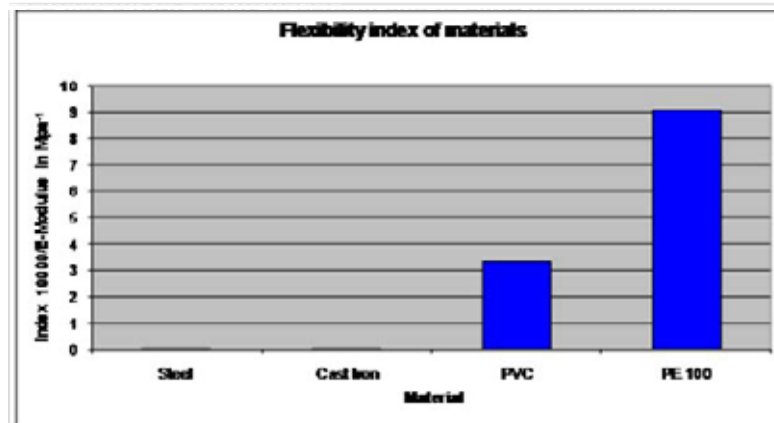
- No effect on drinking water desired
- Materials and pipes shall not affect human health
- Regularly examined on compounds and materials



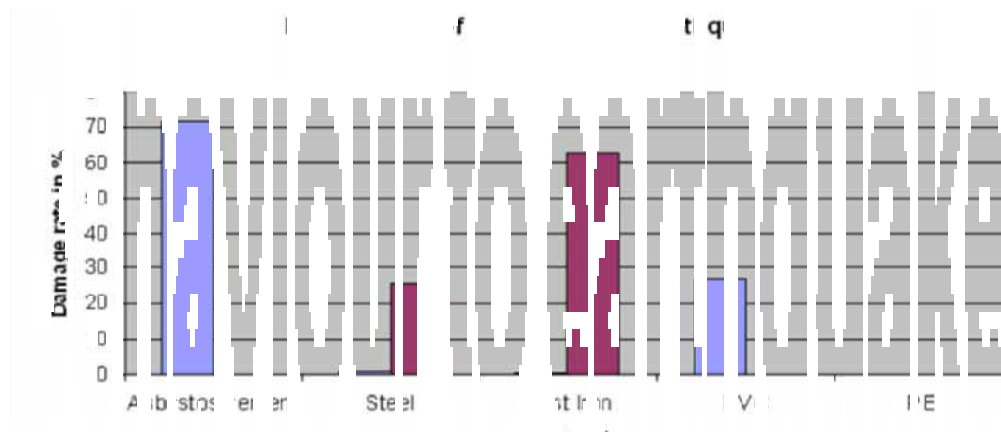
Source: wfb

Behaviour to earthquakes

- There is no test method to mimic the behavior against earth quake
- Generally the higher the sensitivity the better the behaviour
- PE has a high ability to deform and to aling to subsidence



Behaviour to earthquakes



How does SABIC serve this market



What makes PE pipes secure

- ▶ High quality level is laid down in standards

International level

- ▶ ISO 4437 Gas applications
- ▶ ISO 4427 Drinking water applications

European level

- ▶ EN 1555 Gas applications
- ▶ EN 12201 Drinking water applications
- ▶ EN 13244 Water applications, general purpose



What makes PE resins for utility pipes secure

- ▶ **Compounds and pipes are type tested to prove their fit for purpose**
- ▶ **Materials and pipes will be certified on national level**
- ▶ **Certification is monitored by third party institutions**
- ▶ **SABIC carries out process verification tests on own initiative**
- ▶ **Producers have certified quality systems**

PE Pipe Developments

Generation	Period	Development
1st	~1970' s	LD (PE32, PE40) HD (PE50, PE63)
2nd	~1980' s	MD (PE80) HD (Unimodal PE80)
3rd	~present	MD (Bimodal PE 80) HD(Bimodal PE80, PE100, PE100+)

Summary

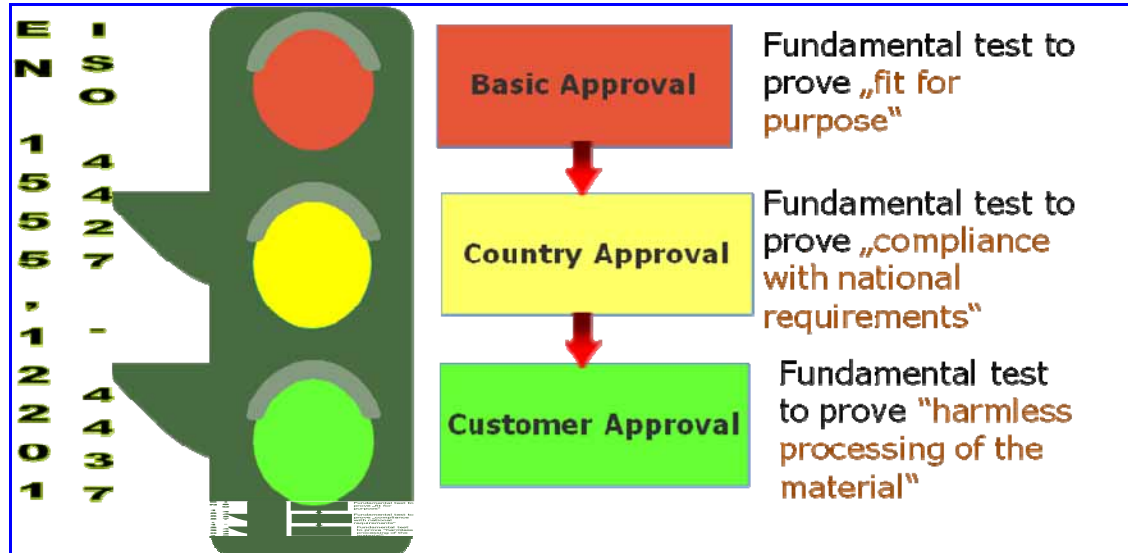
Advantages of PE

- ▶ Safe
- ▶ Long life (e.g. 100 years)
- ▶ Non corrosive
- ▶ Light weight
- ▶ Easy Installation (e.g. trenchless)
- ▶ Leakage free
- ▶ Balance between flexibility and strength
- ▶ Environmental friendly
- ▶ Well controlled systems

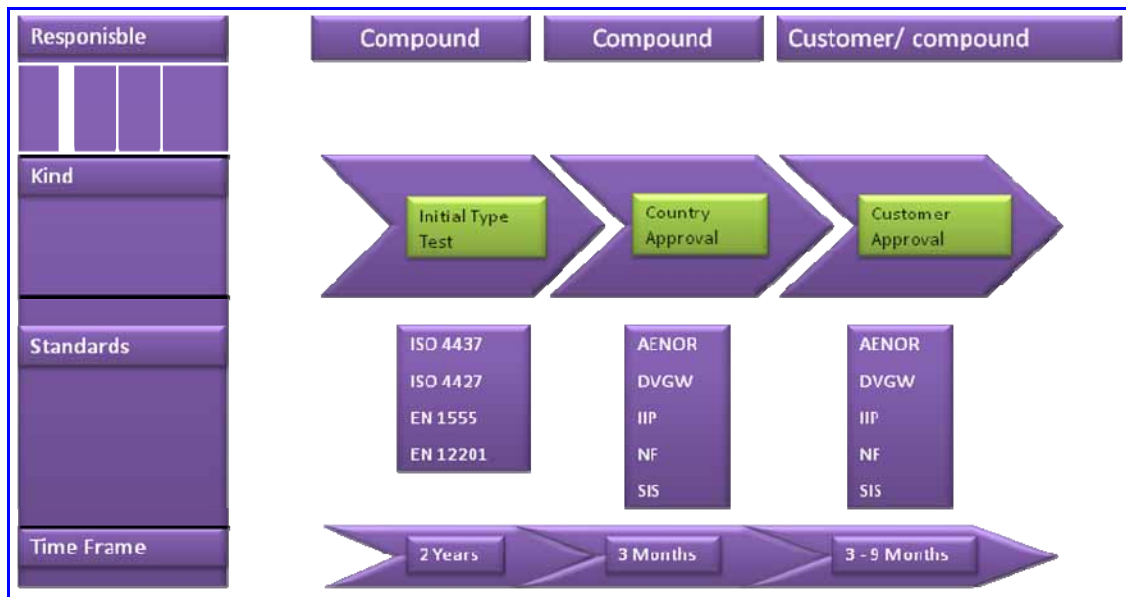


Source: snb

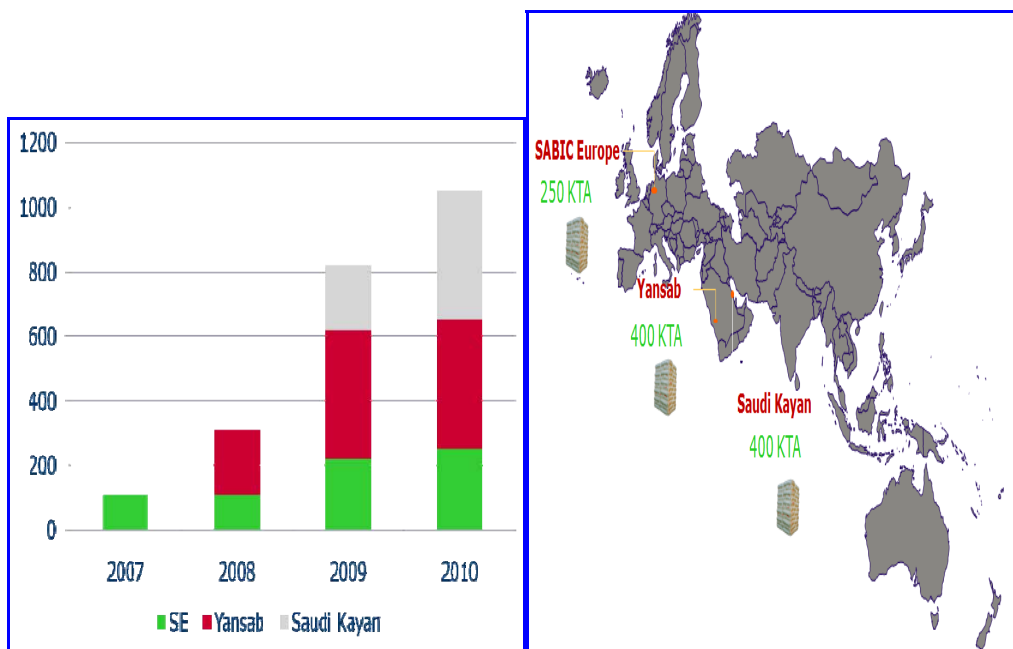
Principle Procedure for PE 100 - Material Approvals



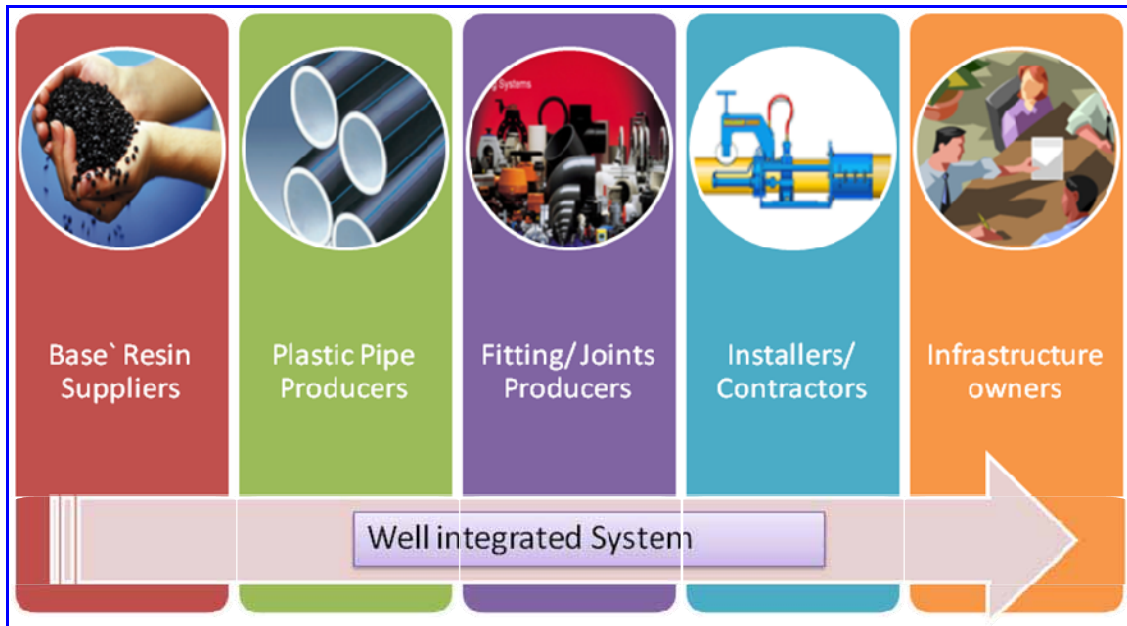
Approval Scheme for PE100



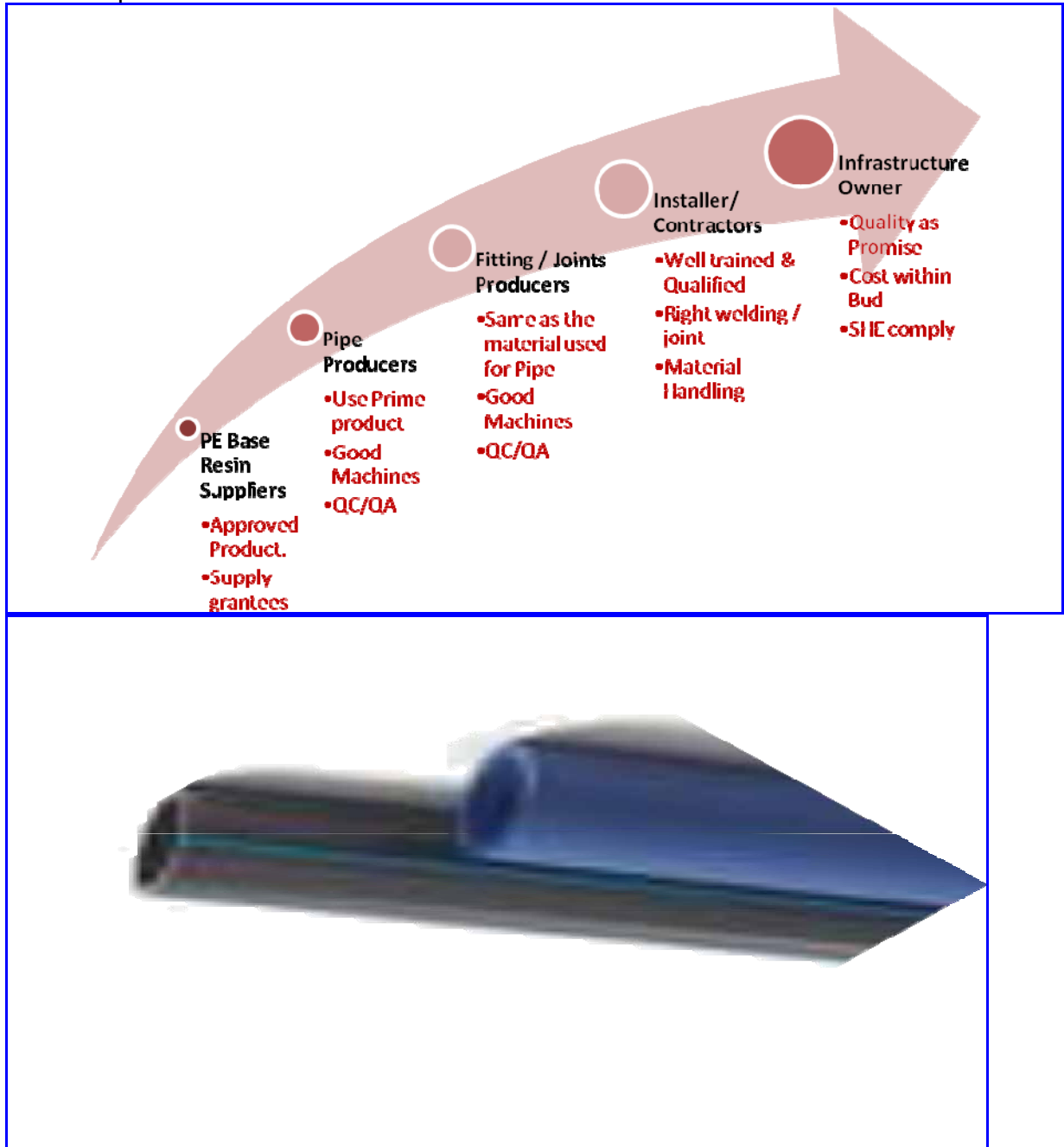
SABIC Bimodal HDPE Pressure Pipe Production Schedule



Business Integration



PE100 Pipe Network



SABIC Contribution to Plastic Industry

- SABIC and Other key players in Plastic Pipe Industry going to form an independent organization (non-profit).
- The name of this organization is **Gulf Plastic Pipe Academy (GPPA)**.
- There will be dedicated office in KSA and utilize SABIC and other member's polymer laboratories.
- Work closely with *Saudi Arabia Standards Organization (SASO)*.

What is GPPA?



GPPA

- Independent organisation for the benefit of all members of the plastics pipe industry

Vision

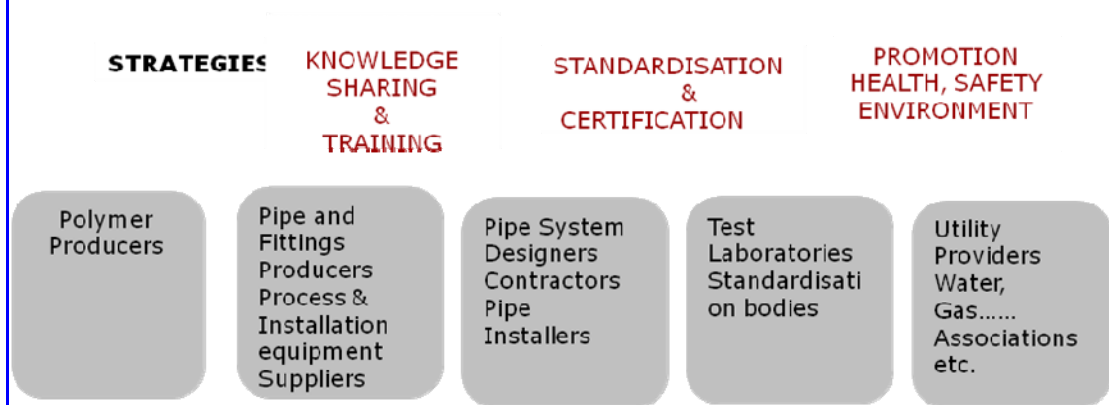
- To promote the use of specified plastics pipe systems and good installation practice for the sustainable development by
 - Engaging its members in information sharing, standardisation and certification efforts
 - Providing education and training on the design, construction and installation of plastics pipe systems and advising on ecological issues
 - Promoting innovative new plastics pipe system approaches

Mission

- PIPES FOR SUSTAINABLE DEVELOPMENT

For more details about GPPA, please visit www.yourppa.org

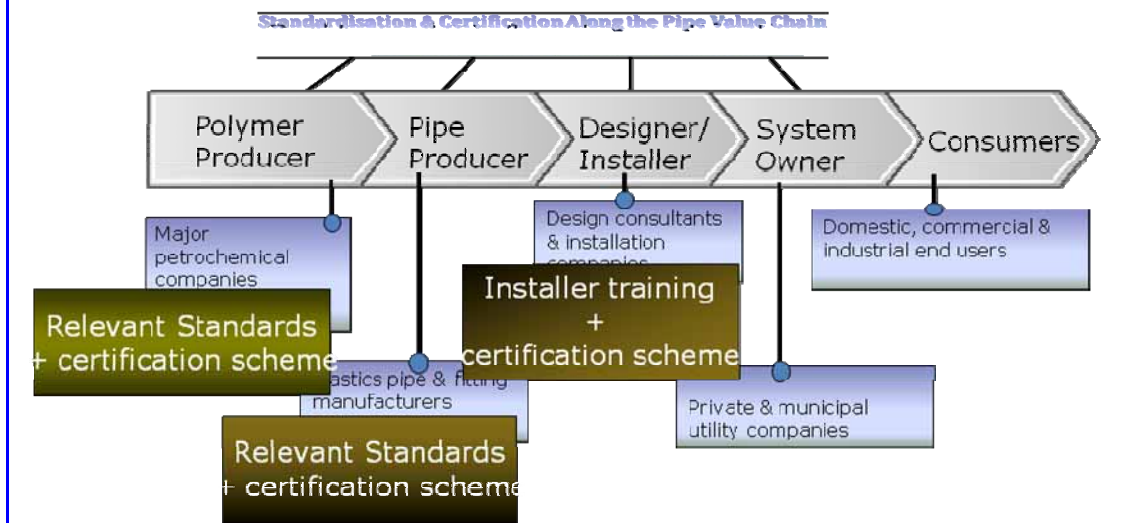
GPPA Strategies & Members



Setting Up a Quality Mark Owned by the Certification Body in Cooperation with All Parties Involved



Standardisation & Certification Along the Pipe Value Chain



Conclusion

- Need to maintain quality to highest level.
- Continue product innovation.
- Build Business Safe Guards
- Ministry of Water to own & participate in GPPA.