

# **POLYOLEFIN PIPES IN THE MIDDLE EAST- TODAY AND TOMORROW**

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## **SHORT SUMMARY**

The paper covers the growth of the polyethylene pipe sector in the Middle East from the 90s to the present. The initial slow uptake was related to ignorance of the material properties from the end users through to designers and installers. Recently the Middle East has become a world leader in the use of ever larger diameters in solid wall and structured wall pipes. Similarly applications in environments previously regarded as hostile are becoming routine. Some important projects on the road from the early days are used to highlight the impressive progress made so far before some speculation on the future of polymers in the Middle East. The introduction of specialist polymers and material combinations is seen as particularly important

## **KEYWORDS:**

*Middle East, PO Pipes, Challenges, Future, Application Development*

## **ABSTRACT:**

The Middle Eastern economy has grown multi-fold in the last two decades, thanks to proven natural resources and the vision of regional governments. Future forecasts also indicate considerable further growth owing to diversification and increased government spending on infrastructure and the industrial segment. The expected non-oil GDP growth of around 3.5% is a positive sign for business.

Even though PO pipes were introduced in the early 1990s, the real growth started in the early 2000s. Failure of conventional materials and ready availability of locally produced raw material have worked as catalysts for the growth of polyolefin pipe applications in water & gas, sewerage & drainage and the industrial & oil and gas sectors.

Consistent efforts to educate the value chain on better understanding the engineering of PO materials have led to improved design practices and specifications more suitable for the Middle East environment. We can therefore expect further market growth in the medium term.

However, with innovation in conventional materials, non-adherence to quality standards and ineffective implementation of quality surveillance systems, we may find further obstacles that hamper the anticipated growth of PO pipes in the region.

## **INTRODUCTION**

The PE pipe sector has grown vigorously over the last two decades. Some of the obstacles to the initial market development are listed here. Some of them persist even today.

1. Lack of suitable regional standards
2. Varied and irrational specifications based on other non-metallic materials
3. Lack of design experience amongst even the international consultants.
4. No independent authority to give guidance on technical issues
5. A lack of engagement with academia – no research focus
6. No skills training for technicians/welders
7. Complete absence of opportunity for designers to learn about PE pipes
8. No attempt to use the knowledge of other users around the globe through recognised industry representative groups.
9. Ignorance of regional environmental regimes such as temperature – atmospheric, marine or buried
10. Entrenched misconceptions on material behavior reinforced by representatives of traditional materials

More recently market share has increased partially as a result of regional investment in raw material production. In parallel the pressure from regional governments to diversity into downstream manufacturing has resulted in a robust pipe manufacturing sector feeding into the still rapidly developing infrastructure of the entire region and an adventurous oil & gas and industrial sector. This diversification initiative continues and will result in further development in the use of PE and PP.

The energetic marketing of the early resin producers was crucial in taking market share from well established 'traditional' materials. Doubts on technical viability and black propaganda were rife but steady progress in cross sector applications encouraged even further investment into the 2000s.

Some of the original technical doubts remain and are still raised as objections to the use of PE. Perhaps the use of overly cautious design criteria remains as still the main obstacle to economic solutions using PE pipe. The need for education in design and understanding of material remains a priority.

Regional agreement on Standards and Design codes remains a far off goal. Fortunately most authorities appear to fall back on ISO documentation. There remains a persistent weakness in the lack of guidance on dealing with the extreme temperature conditions across the geography of the GCC; similarly there is still no definitive study on ground temperatures or acceptance of average air temperatures as a reliable design basis. It is encouraging that more effort is being initiated into developing quality monitoring and quality marking.

## **QUICK OVERVIEW OF PIPE MARKET**

The world plastic pipe market is projected to increase around 6.9% per annum through 2019. Substantial construction activity especially in developing markets such as China, India and the ASEAN countries has had very positive impact on growth. The Chinese market alone is projected to grow by 9%, thanks to continued spending by government on improvement of infrastructure, particularly water and domestic gas distribution.

In terms of the Middle Eastern perspective, it was estimated at 1.1 Million tons in 2014 with a projected CAGR of 6% through 2020 to reach 1.6 Million tons. The robust growth in the Middle East is attributed to continual infrastructure development programmes by the various governments. The application range in the infrastructure segment includes water and gas distribution, cooling water networks, underground firefighting networks. Of late the industrial and the oil and gas sectors have started incorporating PO pipes into their projects with proven successful cases in applications such as internal lining, sea water intakes & outfalls and internal cooling circuits. The ambition of local governments to invest in the downstream industrial sector may pave the way for much further application development in this segment.

## **EARLY DAYS....**

PVC was already well established in the seventies and eighties. It was dominant in the irrigation market and much of the small diameter drainage sector. Low density polyethylene was the material of choice for small diameter dripper run. The market was dominated by traditional materials such as asbestos cement & ductile iron pipes for pressure applications. Some larger pipelines remained in glass reinforced polyester (GRP) or even steel. The gravity market was divided. Overwhelmingly GRP was used for sewage with some clay. Storm water was further divided between asbestos cement and plastic lined reinforced concrete pipes in Abu Dhabi and elsewhere. PVC was used almost universally for the distribution of treated sewage effluent and small diameter drainage.

In 1997 Borouge began pre-marketing PE100. At that time they estimated that PE held only 2% of the pipe market. Almost coincident with the Borouge plan to produce resin in the region, many local PVC and asbestos pipe makers made major investment in PE extruders; the first confident move into the non-PVC plastic pipe market within the region. These investments covered not only solid wall pressure pipe but also larger diameter gravity pipes. This was a bold decision and gave the investors the difficult task of persuading their customers that PE pipe was viable technically

and economically. The objections raised to the introduction of plastics pipes were strikingly similar right across the region and indeed the 'doubts' have not changed over the succeeding ten years or so.

The evolution of PE pipes has faced many challenges in this region which is unique having a preponderance of greenfield urban infrastructure development. In the absence of proven or practical documentation for the given environmental conditions, quite often pipes are designed to extreme/arbitrary conditions, which in turn increases the overall project cost.

## **TWO DECADES AND ON**

The most noticeable change in the water and sanitation sector has been the accelerated move to the introduction of polyolefin resin manufacturing. Now the GCC has become the global centre for resin production. Major producers such as Borouge, Sabic and Tasnee are not only investing in production facilities but also in strong research and development teams. Now the industry is more confident in the use PO pipes. And, importantly, investments made by regional resin producers effectively force local industry to use locally produced materials.

PE has been reluctantly accepted as an inevitable change in many areas of the Middle East for the distribution of water but it is still not a universal choice largely because of lack of confidence and the well-entrenched position of competitor materials.

We see little improvement in the knowledge gap amongst designers but we have seen a very much raised awareness of this lack and an admission that further education is needed. All of these changes require a concerted effort in education and training and in establishing a consistent approach to design and installation.

## **KEY DRIVERS FOR FURTHER GROWTH**

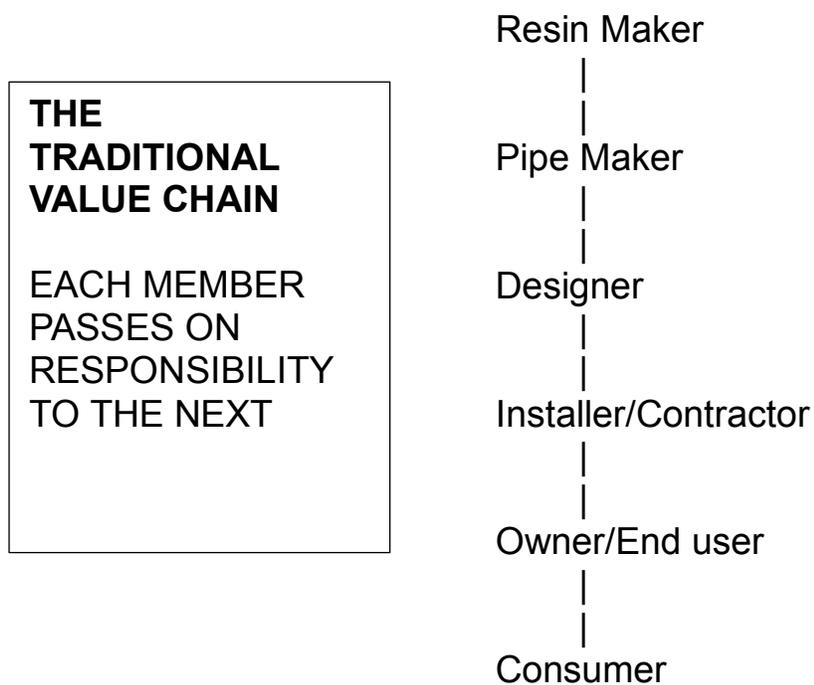
### **Knowledge gap across value chain.**

We now recognize that the objections/misconceptions have arisen because throughout our region there is a profound knowledge gap. Few of the engineers we meet have a full understanding of the properties of the materials we deal with. Most have no clear idea of how the design process must be modified to take into account the differences in behavior between thermoplastics and traditional elastic materials. There was a clear need for constant education across the entire value chain in order to bridge this knowledge gap. Especially in terms of having standards/industry guidelines with conditions related to the Middle Eastern environment which should include advice on temperature, pressure, installation conditions and site testing.

## Standardisation and Certification:

We found initially that there were perhaps too many standards and there was an element of confusion particularly amongst end-users and many of those responsible for preparing specifications. There is a need to rationalize this situation by encouraging regional unity without appearing to favor one set of national standards over another. In this debate the most positive response has been for the adoption of ISO standards. National and regional quality conformity organisations should be more active in promoting their quality mark programs which in turn help to maintain a consistent quality across the market. The recent work of the Abu Dhabi Quality and Conformity Council has been a great example to others in the region in encouraging consistency of approach in all matters of standardization and quality maintenance right across the Gulf states. Having passed the stage of agreeing on quality standards, surveillance becomes the next critical stage in achieving these aspirations.

## VALUE CHAIN INVOLVEMENT:

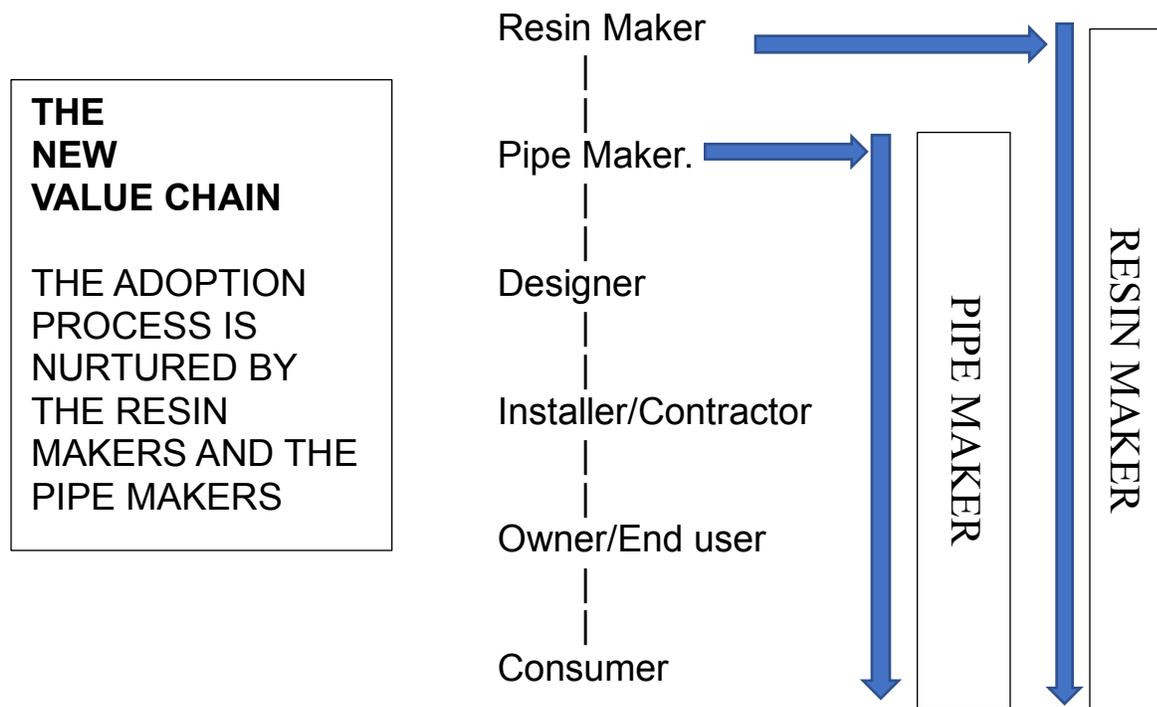


The history of the development of the PE market in the Middle East is remarkable for the way in which the principal resin maker Borealis/Borouge and the few pioneer pipe manufacturers in the region were proactive in approaching organisations further down the pipe value chain. They used technical staff conversant with pipe design to cooperate with the engineering teams involved in decision making. They changed the traditional model which was to effectively abandon responsibility for the pipes as they left the factory gates. The new approach was engagement right down the value chain and to stand by the product through installation and commissioning.

To some extent one particular global pipe manufacturer was responsible for this approach by insisting that its technology agreement with the main regional player was conditional upon them recruiting engineering staff to deal directly with the designer consultants. They felt that to introduce the relatively new material it was insufficient to deal only with the procurement divisions of the contractors. The designers, the installers and the end users were all to be given the opportunity to learn about PE. The objective was to be involved with the decision making on material choice at the earliest stages of project development. Without this proactive approach the fear was PE would always come second to established technology.

This model bore results almost immediately with the award of major projects in the regional for large diameter pressure and gravity projects.

Effectively the old model of the value chain was disrupted.



The consumer is a recent entrant to the value chain, not always seen in past representations. Today we must take note of the environmental concerns of those who actually pay for the activities of everyone above them on our value chain. It is not enough to believe the packaging sector will remain the main recipient of criticism. We must also examine our role in preserving our environment and be prepared to answer difficult questions in the future.

## **NEXT TWO DECADES:**

Tomorrow will bring us new materials and new methods of manufacture. Many developments have been in response to market requirements but others promise to be unexpected.

Here are some of the areas we believe will yield the biggest advances in the next two decades.

### **Material advances**

- Multilayer systems
- Nano particle addition carbon and other materials currently under assessment in Khalifa University
- Advanced RTP. Increasing the pressure temperature envelope
- Resistant materials. – chemicals chlorine heat cold abrasion cracking
- Intelligent material. Automatic Defect detection and self-repair
- PE 125+
- High Temperature resistant and extremely sag resistant material
- 3D printing of fittings

### **Engineering**

**Larger diameters:** 4000mm (14 feet) for gravity pipes already achievable and may go up to 5000mm, especially in industrial projects.

**Higher pressures** – increases opportunities in long distance transmission and in oil applications

**Super crack resistant** – Improves the use of PE in lining applications and subdues fears over poor backfill.

**Design Manuals** – the introduction of design manuals aimed at civil pipe designers. Digital design will become the norm

We still have hurdles to overcome and new issues arise continually. In the Middle East we are currently facing the major problem of the increasing use of chlorine dioxide for routine disinfection. Previously only used in the paper industry as bleach it is an extremely effective biocide but comes with inherent disadvantages. It is an unstable substance and has a history of explosive incidents. It is extremely reactive and even at tiny concentrations will attack PE, PP and many other polymers. It is not clear why this somewhat dangerous substance was introduced but it is already causing failures in parts of the region.

Quality control is better than ever but still needs improvement. We hope the next ten years will see increasing cooperation across the Middle East to unify and rationalize standards and specifications. We need an industry organisation to supervise and encourage this.

We have a vibrant PE industry currently suffering from an oversupply of pipe manufacturing capacity. The inevitable result has been corner cutting, to maintain competitive edge in a cut throat market. The inevitable failures are now showing up throughout the region. Our previous remarks on quality control become even more important. We know from bitter experience that the end user authorities quickly lose confidence when quality is so easily compromised and the consequences are disruption and extra expense. For the same reasons PE has been banned in other locations so we must treat this form of cheating with great concern to ensure similar bans are not initiated in the Middle East.

On a more positive note we believe the Middle East will further establish itself as the world leader in high quality resin production. It will continue to push the engineering boundaries and we will see applications for our pipes we never thought would be possible.

## **CASE STORY –URBAN INFRASTRUCTURE**

'Musaffah ' is located 25KM south west of UAE's capital Abu Dhabi. The busy industrial and residential area has over 150,000 populations. In year 2002 in view of growing population local authorities, responsible for urban infrastructure planned for pipeline to pump sewage water to a nearby treatment which is 9KM away from strategic collection point. The plan was to use the treated water for irrigation and landscaping purpose.



Local authorities carried out a comprehensive analysis and planned to install twin lines of 1200mm GRP pipes in this project. However the local pipe manufacture Union Pipes Industry (UPI) along with local resin producer Borouge demonstrated the great advantages of HDPE Pipes which have more than 25 years of history in the West compared with traditional materials. The implicit advantages such as flexibility, non-corrosiveness and low friction properties managed to beat conventional materials on the Whole Life costing approach. These benefits encouraged local authorities to consider HDPE as an alternative to GRP.



As there are no 1200mm pipe extruder available during that time 4 parallel line of 630mm were designed in place to one 1200 ID GRP pipes. The new design was fit for the purpose and also provided flexibility to the operator to use individual lines depending on the load.

A total 8 lines of 630mm, SDR-17; PE-100 pipes were installed. As this is the first major project with HDPE pipes, extra care was taken by the value chain and proper training was provided to the relevant parties in pipe manufacturing, testing, welding and installation. Horizontal Directional Drilling (HDD) was used to cross a major express highway. More than 150 EF couplers were used in the project along with more than 9000 butt welded joints.

This pioneering project was commissioned in 2005 and since has successfully operated with no reported failures/concerns. By far this remains "the" biggest PO urban infrastructure project in the region.

## **CONCLUSION:**

The success of the pioneer investors in the 1990s and early 2000s in opening up the PE markets in the Middle East must be acknowledged as a triumph. From a 2% market share we have approaching one third of the entire pipe market and continue to take away from other materials.

Further development will be driven by the increasing regional investment in resin production consolidating the region as the world leader in plastics. The resin makers are also putting faith in long term material research which adds to the successful formula.

Along the road many hurdles were encountered from well entrenched competitor materials to misconceptions on design and lack of agreement on basic environmental variables. Perhaps the most difficult to deal with has been the conservatism brought in by designers uncomfortable with the new material. Perversely this conservatism remains and continues to produce unfavourable economic comparisons with other materials through over cautious design.

A consistent design approach based on regionally accepted methodology and agreed standards has to be a crucial target for the next decade. So far we have been slow to achieve any progress in this respect. Let us hope this will change.

Efforts must continue to educate the entire value chain capitalizing on the robust approach introduced by the early pioneers. There has been some success such as the introduction of welder training by SKZ but there remains a knowledge gap particularly within the design community.

The regional industry is now healthy and vibrant but competition amongst pipe manufacturers has introduced pressure to preserve margins by the 'cutting' of quality material with imported recycled scrap and poor quality film grade. The damage to the reputation of the entire industry is a serious threat to our future.

New materials are being introduced opening new horizons for the application of PE. The possibilities of multilayer pipes and the addition of new property enhancing materials to the mix have only just begun to be explored.

There is a catalogue of firsts in our area from giant offshore pipelines to the longest directional drill of a large diameter pipe in the entire world. Projects get bigger and our grip on standard infrastructure tightens. We learn from mistakes but sharing of this knowledge remains poor. An industry representative group is required; perhaps the next decade will provide such an organization.

Overall we should be optimistic but not complacent. Much effort is needed to fully capitalize on the brilliant efforts of those investors and planners from two decades ago. The Middle East sector is still fragmented in its approach to design and quality. The next two decades will we hope see a more integrated approach to facing our competitors and solving the persistent technical hurdles to universal adoption of PE.