

# Practical Aspects of Large Diameter HDPE Pipe Production

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PLASTIC PIPE  
CONFERENCE  
Philadelphia, PA • April 16-17, 2019  
Presented by the SPE Philadelphia Section

# Large OD HDPE Pipe: An Overview

- The Market for Plastic Pipe
  - Global Market
  - North American Market
- The Evolution of Large OD HDPE Pipe
- Practical Aspects of Large Diameter HDPE Pipe
  - Raw materials
  - Material handling
  - Production equipment
  - QA procedures
  - Shipping and handling
  - Joining
- Questions & Answers
- Concluding Remarks



# Global Demand for Plastic Pipe



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# Global Demand for Plastic Pipe

- Industry sources project a healthy demand for plastic pipe through 2023
  - Freedonia, AMI, PPI, Private client studies
- Plastic pipe demand (all plastics) is projected to rise at a rate of 6.5-6.7% per year on a global basis.
- Global construction is the key driver for continuing growth in demand for plastic pipe
- PVC is still expected to remain the dominant plastic pipe material with an annual growth rate of approximately 6.0-6.3% per year.
- HDPE (all types) is expected to gain market share from PVC with an annualize growth rate of approximately 7.2-7.4% per year.
- Combined, PVC and HDPE hold approximately 90-92% of the overall plastic pipe market on a global basis.

# Global Demand for Plastic Pipe



- Key drivers for continued growth in plastics piping
  - Extremely attractive strength-to-weight ratio
  - Chemical/corrosion resistance
  - Ease of installation
  - Long-term durability
  - Joining techniques
  - Cost-effectiveness across various end-uses
- Above average growth rates (> 6.7% per year) expected for newer market entrants
  - Cross-linked polyethylene (PEX)
  - Polypropylene (PP)
  - Polyethylene with raised temperature resistance (PERT)
  - Engineering resins (PVDF, etc)
  - Others

# Global Demand for Plastic Pipe

World Plastic Pipe Demand by Resin (in ktons and pounds)				
Material	Year			
	2009	2014	2019	2024
PVC (metric ktons)	13060	17620	23950	31450
PVC (million pounds)	28732	38764	52690	69190
HDPE (metric ktons)	7070	10920	15550	21190
HDPE (million pounds)	15554	24024	34210	46618
Other (metric ktons)	1670	2320	3250	4360
Other (million pounds)	3674	5104	7150	9592
Total Plastic pipe (metric ktons)	21800	30860	42750	57000
Total Plastic pipe (million pounds)	47960	67892	94050	125400
PVC % of total	59.9	57.1	56.0	55.2
HDPE % of total	32.4	35.4	36.4	37.2
Other % of total	7.7	7.5	7.6	7.6

Source: Fredonia Group

# North American for Plastic Pipe

North American Plastic Pipe Demand by Resin (in kton and pounds)				
Material	Year			
	2009	2014	2019	2024
PVC (metric ktons)	2713	2887	3969	4935
PVC (million pounds)	5968.6	6351.4	8731.8	10857
HDPE (metric ktons)	1176	1666	2369	2936
HDPE (million pounds)	2587.2	3665.2	5211.8	6459.2
Other (metric ktons)	236	277	352	434
Other (million pounds)	519.2	609.4	774.4	954.8
Total Plastic pipe (metric ktons)	4125	4830	6690	8305
Total Plastic pipe (million pounds)	9075	10626	14718	18271
PVC % of total	65.8	59.8	59.3	59.4
HDPE % of total	28.5	34.5	35.4	35.4
Other % of total	5.7	5.7	5.3	5.2

- North American market still largely dominated by PVC pipe according to independent sources
- PVC CAGR over 2019-2023 projection period = ~ 4.0%
- PE CAGR over 2019-2023 projection period = ~ 5.3%

Source: Freedonia Group

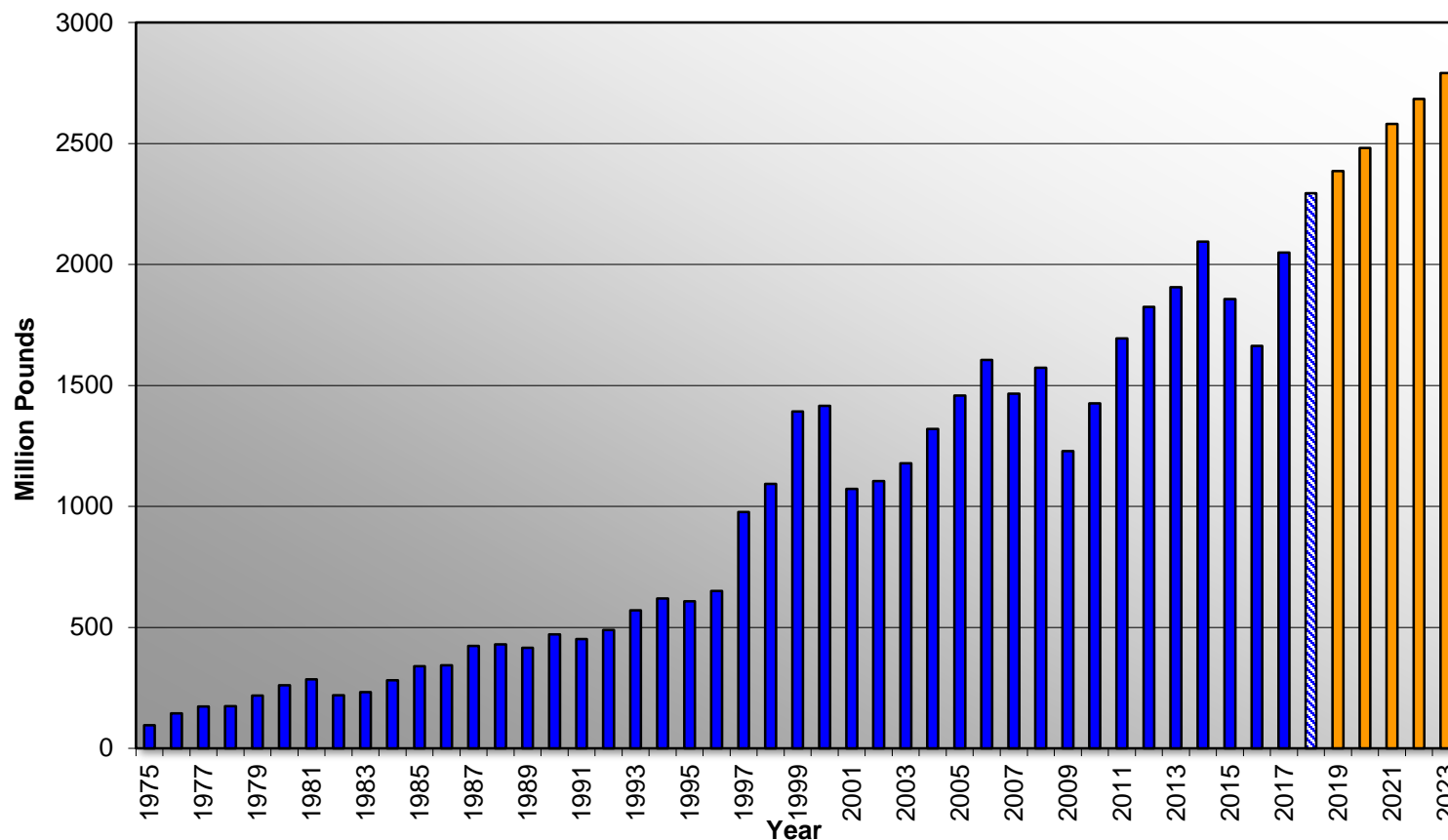
# North American Demand for Plastic Pipe

- Health of North American Market for plastic pipe is borne out by both independent resources and PPI Statistics
  - Fredonia
  - AMI
  - Private client studies
- PPI statistical reports:
  - Offer more accurate insight into HDPE pipe sales within North America
  - Focus in on HDPE pipe grades HDPE pipe shipments going back to 1975
  - Can strip out non-pressure rated corrugated or drainage grades to focus on pressure-rated HDPE grades



# North American Demand for HDPE Pipe

## PPI Total HDPE Market Projection



Note: Total HDPE market projection includes PEX but does not include non-pressure or corrugated HDPE pipe shipments

Source: PPI Statistics Reports

# Growth of HDPE Pipe Market

- Despite some cyclicalities, sustained growth and expansion in traditional HDPE pipe end-uses
  - Water service
  - Gas distribution
  - Oil patch
  - Conduit
  - Other
- “Discovery” of the value proposition for large diameter HDPE pipe by engineering community
  - Municipal water transmission
  - Industrial process water
  - Ocean intake/outfall systems



# Growth in HDPE Pipe Market



- Key drivers in continuing expansion into larger diameters and heavier walled HDPE
  - Performance capability of HDPE in demanding applications
  - Material advancements
    - PE4710
    - PE100RC
  - Innovation in production technologies
  - Advent of “long-length” production
  - Advancements in fusion joining technologies
  - Fittings design and availability
  - Continuing recognition in standards arena
    - ASTM, AWWA, ISO, ASME, Other
- Large diameter HDPE pipe today
  - ASTM D3035 through 65” IPS
  - ASTM F3123 through 2500 mm
  - ISO 4427 through 2000 mm
  - EN 12201 through 2500 mm

# Practical Aspects of Large Diameter HDPE Pipe

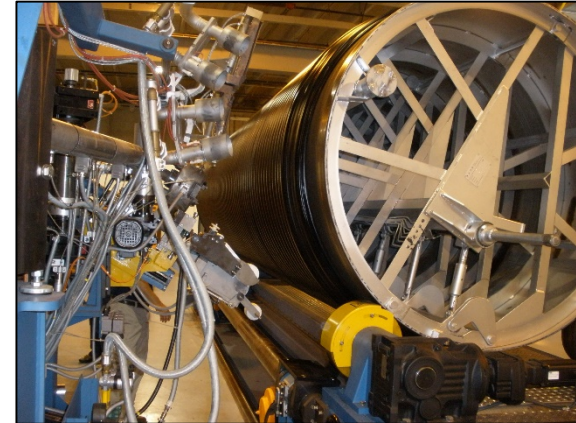
- While any of the factors contributing to growth in large diameter HDPE are worthy of extensive discussion
- This discussion will focus on the practical aspects of large diameter production
  - Raw materials
  - Material handling
  - Production equipment
  - QA procedures/practices
  - Shipping and handling
  - Joining





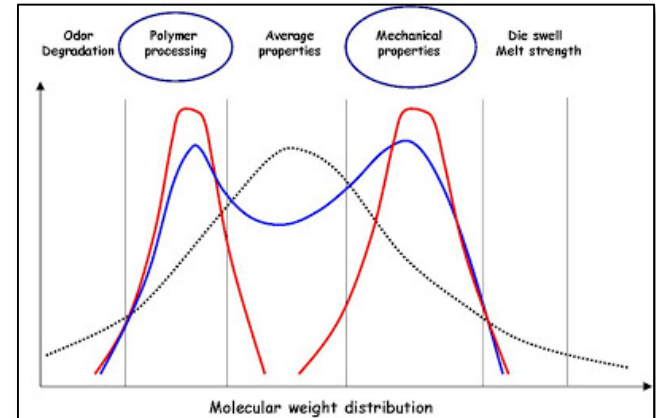
# Practical Aspects of Large Diameter HDPE Pipe

- For purposes of discussion:
  - Spiral wound large diameter HDPE pipe has been around for some time
  - Technology is viable and has contributed to global growth in HDPE pipe demand
- Today's discussion will focus on conventional in-line extrusion of large diameter ( $\geq 2000$  mm) HDPE pipe



# Practical Aspects: Raw Materials

- Selection of feedstock materials is extremely important
  - PE4710
  - PE100/PE100RC
- Melt strength and resin qualification becomes a key component of the planning process
- Example:
  - 2500 mm DR 17
    - Wall = 147.1 mm (5.79")
    - Weight/ft = 738 lb/ft
- Additional consideration - precompounded feedstock versus in-plant blends of natural and masterbatch
  - Uniformity of carbon black distribution
  - Heat intensification due to blending affecting melt strength
  - Impact on pipe quality and QA requirements
  - Standards compliance



# Practical Aspects: Material Handling

## Large Diameter PE100/PE4710 Pipe Properties

Nominal Diameter		Pipe DR											
		17			21			26			33		
Mm	inch	wall (mm)	wall (in)	Lb/ft	wall (mm)	wall (in)	Lb/ft	wall (mm)	wall (in)	Lb/ft	wall (mm)	wall (in)	Lb/ft
2000	78.7	117.6	4.6	473	95.2	3.7	385	76.9	3.0	312	60.6	2.4	250
2500	98.4	147.1	5.8	738	119.0	4.7	601	96.2	3.8	485	75.8	3.0	393
3000	118.1	176.5	6.9	1062	142.9	5.6	865	115.4	4.5	701	90.9	3.6	566
3500	137.8	205.9	8.1	1446	166.7	6.6	1178	134.6	5.3	954	106.1	4.2	771

### Notes:

- 1) Wall thicknesses shown are based on EN12201 and ISO 4427
- 2) Pipe weights are approximated based on nominal diameter and pipe wall shown
- 3) Values shown in red are hypothetical only and not proven based on current commercial practice

# Practical Aspects: Material Handling



- Large diameter pipe requires a “lot” of material
- 2500 mm DR 17 example
  - Assume 6 50’ foot joints per day
  - 221,400 pounds per day
  - 9,225 pounds per hour
- On site inventory becomes key to uninterrupted production
- Resin conveyance capacity and reliability can be a factor as well
- Incoming QA of feedstock materials at these volumes is important



# Practical Aspects: Production Equipment



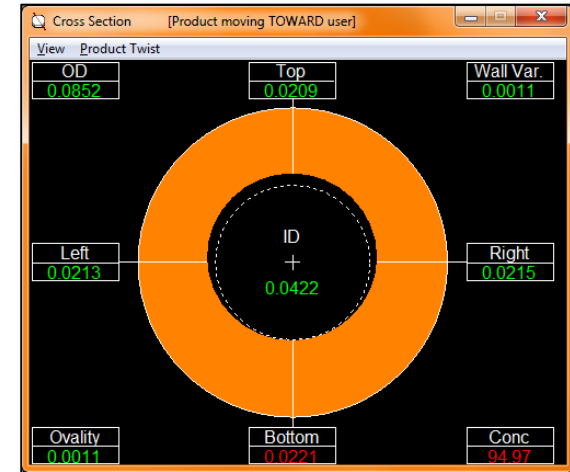
- Think “BIG”
- “BIG” pipe requires “BIG” equipment
- Space requirements becomes a major aspect of planning process
- Single versus multi-extruder configuration
- Highly specialized extrusion equipment
  - Dies
  - Vacuum/Cooling tanks
  - Pullers
  - Cut-off and
- Loads become a major consideration
  - Bridge crane or hoisting capacity

# Practical Aspects: Long Length Production



# Practical Aspects: QA Procedures/ Practices

- QA requirements are largely set by production standards
  - ASTM or ISO or EN
  - Resin qualification
  - Resin inspection
  - Workmanship
  - Diameter
  - Wall thickness
  - Carbon black content
  - Tensile strength
  - Melt index
  - OIT
  - Marking requirements
  - Batch release testing
- At these volumes, on-line process control and production automation become critical
  - Extrusion process parameter monitoring
  - Automated wall monitoring
  - Integrated process control
- Particularly, in long-length production



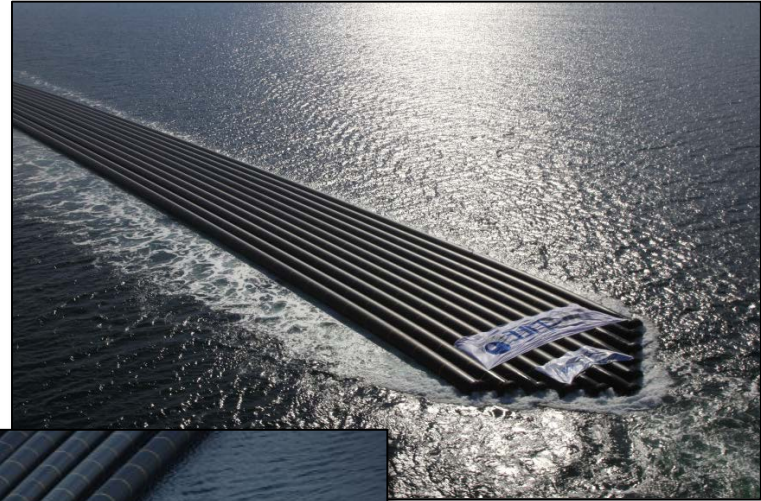
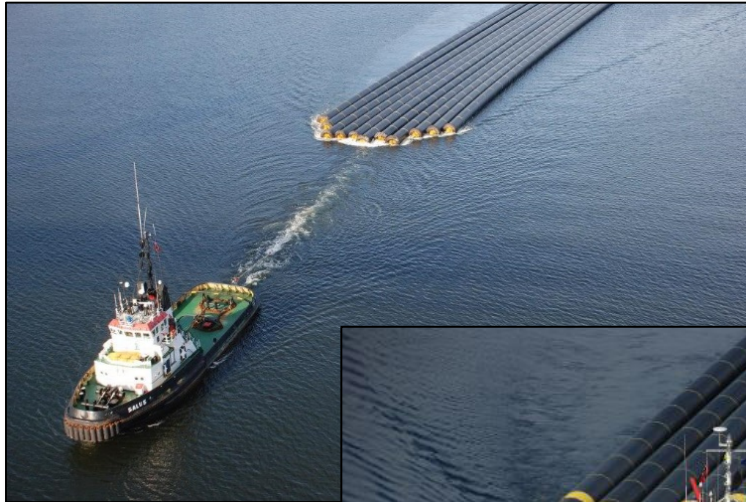


## Practical Aspects: Shipping and Handling



- Think “BIG”
- Large diameter HDPE pipe creates shipping and handling challenges
  - 50’ 2500 DR 17 = 37,000 pounds
  - 1500’ becomes 1.1 million pounds
- On site handling and storage requires some creativity
- Dedicated loads or special permitting for extremely large diameter pipe
- Long length, marine production

# Practical Aspects: Shipping and Handling





## Practical Aspects: Joining

- Butt fusion has been and continues to be key to the expansion of HDPE pipe demand
  - Time-proven technology
  - Standardized fusion procedure
    - ASTM F2620
    - DVS 2207
  - Joint integrity
  - Flow stream security
  - Job-site efficiency
  - Evolution in technology and productivity



## Practical Aspects: Joining

- New set of challenges as we consider large diameter HDPE
  - Pipe fusion
  - Fitting production and joining
  - Job-site planning
    - Think “BIG”
    - Space requirements
    - Load handling



Tecnodue 3130 Fusion Machine



Widos 2600 Fusion Machine

# Large Diameter HDPE Pipe: Concluding Remarks



- Larger diameter HDPE pipe production (> 2000 mm OD) poses some unique challenges.
- However, the basic process is the same as smaller diameter. The challenges are scaled up significantly.
- Advancements in resin and production technology have been instrumental in setting the stage.
- Introduction of these larger diameters and heavier walls opens the door for new applications
  - Intake and outfall
  - Industrial process water
  - Hydro-electricity
  - Ocean Clean-up





# Questions?

# Thank you!

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