PVC AUS Pipe conference
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Quality on PVC-O

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The Netherlands
1. Short introduction Rollepaal
Rollepaal Holding I

Rollepaal Holding is a group of companies:
Rollepaal BV Dedemsvaart, The Netherlands

- Developing plastic pipe extrusion technology since 1962
- Part of the Wavin Group and independent since 2001
- Independent worldwide supply of equipment
- Dedicated people in pipe extrusion process
- Focus on sustainable solutions
- In PVC-O business since 1995
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Rollepaal Engineering India, Ahmedabad, India
- Manufacturing of Inavex extruders
- Manufacturing of Dosteq dies and downstream
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Rollepaal Engineering India, Ahmedabad, India
  Manufacturing of Inavex extruders
  Manufacturing of Dosteq dies and downstream equipment
Rollepaal Inc., Baltimore, USA
  Parts manufacturing for the Imperial Sizes
  Assembly of Rollepaal Extrusion lines
Rollepaal Indonesia, Djakarta, Indonesia
  Sales and service centre
Companies also in the group Rollepaal Holding

- PPR-C 32 cavity mould
- PE 500 PN 16 mould
- PPSU moulds high temperature
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PPR-C 32 cavity mould

PE 500 PN 16 mould

PPSU moulds high temperature

S&B, dies, Rollepaal parts

Parts shipping industry
Parts rubber and plastics industry
Parts food industry
Companies also in the group Rollepaal Holding

- **Rollepaal Holding II**

- **ppr-c 32 cavity mould**

- **PE 500 PN 16 mould**

- **PPSU moulds high temperature**

- **S&B, dies, Rollepaal parts**

- **Parts shipping industry**

- **Parts rubber and plastics industry**

- **Parts food industry**

- **Feeders**

- **Continuous Assembly lines**

- **High speed assembly lines**

  2000 parts per minute
2. PVC-O production techniques
Two different process principles

**Water Based / Air based**

**Off-Line (batch)**
Orientation unit is not connected to the extrusion process/die head. Feedstock extrusion is independent from orientation process.

**In-Line**
Orientation unit direct connected to the extrusion process. Feedstock extrusion and Orientation is one in-line process.
The different PVC-O technologies

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**Water Based / Air based**

- **Off-Line**
  - YIP-Uponor 1982
  - Uralita
  - Alphacan 1998
  - Pipelife

- **In-Line**
  - Petzetakis 1972
  - Upo-Vinidex 1996
  - Wavin 1995
  - Alphacan 2000
  - Pipelife 2001
  - Molecor 2006
  - Rollepaal 2009
The different PVC-O technologies II

The in-line, its strength:

1) High production speeds
2) Guaranteed continuous Bi-Axial orientation
3) All pipe lengths are possible to make, newest developments 12 and 20 meters pipe
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2) Guaranteed continuous Bi-Axial orientation
3) All pipe lengths are possible to make, newest developments 12 and 20 meters pipe
4) In-Line process for both extrusion and orientation of pipe giving best controlled oriented product
5) Do process MRS 50 (500) and PN 25 standard
6) Double calibration on the inside and outside of the pipe
The in-line, its strength:

1) High production speeds for extrusion, orientation and socketing
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7) Air based clean and save operation
Different PVC-O technologies II

High production speeds for extrusion, orientation and socketing
1) Guaranteed Continuous Bi-Axial orientation
2) All pipe lengths are possible to make, newest developments 12 and 20 meters pipe
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5) Double calibration on the inside and outside of the pipe
6) Air based clean and save operation

The in-line, its weakness:

Water can transport more energy, in-line water PVC-O solutions are around 15% shorter in length.

1) Limited to range 90-630 mm
2) Line length
3) Process more complex, but automation made it more simple
The off-line, its strength:

1) Technology is more simple
2) Possible to make larger pipe sizes than 630 mm
3) can process MRS 50 (500) and PN 25
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2) Possible to make larger pipe sizes than 630 mm
3) can process MRS 50 (500) and PN 25
4) Line length is short (squared production area)
5) Air based improved output and energy efficiency
6) Belling can be included in the mould
7) Maximum pipe length is given by the mould size, most of the time 6 meter
8) No internal calibration, variations in wall thickness forces overweight pipe
9) Min scrap rate by End Caps
1) Technology is more simple
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The off-line, its weakness:

1) Processes looks integrated but still discontinuous (extrusion)
2) Most of the pipe is mono-axial stretched
3) Maximum pipe length is given by the mould size, most of the time 6 meter
4) Min scrap rate by End Caps
The off-line, its weakness:

4) No internal calibration, variations in wall thickness forces overweight of pipe
5) No integral quality control lead to higher scrap rates and pipes out of spec

1) Automatic technology, continuous but intermittent (extrusion not included)
2) Possible to make larger pipe sizes than 630 mm
3) Line length is short (squared production area)
4) can process MRS 50 (500) and PN 25
5) Belling can be included in the mould
6) Air based increased output and energy efficiency
7) Maximum pipe length is given by the mould size, most of the time 6 meter
8) Overweight is even not considered in the off-line process.
PVC-O technology in socketing

Off line:

➢ Free expansion process in orientation unit: variation in walls thickness and eccentricity critical in socketing application   ISO 16422

➢ Integral bell-spigot socket challenged by rubber ring lock

outside of the pipe is in spec
Inside of the pipe not controlled and Causing problems with rings

➢ Pipe is more stretched at the socket so the wall thickness becomes critical by in-mould socketing

Off-line solutions critical towards quality socket
Belling machines use in-line biaxial orientation to secure wall thickness in the pipe (section A). Belling machines secure in inner sizes of the PVC-O pipe (section B).

Section A: Control min wall thickness: two solutions:

1. Biaxial oriented pipe: length orientation is released to thicken the pipe
2. Mono axial oriented pipe: pipe end is forced to shorten to get thicker pipe
3. Quality in production
In-Line Air based technology:

1) Double Calibration of the oriented product from the outside and from the inside

2) Genuine Air system (Clean and Safe)

3) Quick Start-Up give low Start up Scrap-rates

4) Flexible & Efficient
   High Productivity against Low Energy consumption
RBlue maximum quality

Air based technology

1) Double Calibration of the oriented product from the outside and from the inside
2) Genuine Air system (Clean and Safe)
3) Quick Start-Up and lower Scrap-rates
4) Flexible & Efficient
   High Productivity against Low Energy consumption

Plug and Play:

5) Full in-house testing & training before commissioned on site (SAT): production start immediately after SAT

6) Standard 5 years process aid by 2-3 times per year check on quality, scrap rates, overweight and production upgrades
Dedicated PVC-O feedstock extrusion technology

7) Special screws and extruders developed to have no screw marks so lowest waviness and therefore lower overweight in oriented products

![Special screws and extruders](image1)

8) Special Triple Compression Dies developed to make the lowest waviness and therefore lower overweight in oriented products. Also the eccentricity is easy to control. At the end of the die there is high end ATC for wall thickness control

![Special Triple Compression Dies](image2)

Best feed stock pipes gives best oriented pipes!
RBlue maximum quality

An in-line process with highest level of automation:

9) All machines are integral controlled after installation by IP addresses and on-line computer control on extrusion, orientation and socketing

10) Everywhere data collection: maximum process window for extrusion, orientation and socketing.

11) Full automated, hands off principle: industry 4.0 => results in lowest scrap rates (<3%) and lowest overweight (3-4%) and highest production output rates
RBlue Cockpit: maximum quality control

Everywhere data collection and analysis
integral process control on extrusion, orientation and socketing
4. Quality in new developments
Couplers in the PVC-O market

Moulding solution

Couplers of PVC-O

1) Mould type, developed by Molecor in line with their off-line PVC-O pipe production make from feedstock an end product by moulding

2) Bending type, developed by Rollepaal first make the pipe with sockets, then bend it in special machine. First parts made in 2013, first tests executed in 2014, presented in Chicago 2014 PP XVII
PVC-O Moulding solution

Same issues to be expected with off-line sockets on pipe as shown before

The different PVC-O technologies IV

6) Free expansion process in orientation unit, thinner walls become thinner, wall thickness problems occur, some producers have 30-35% of produced pipe out of ISO 16422

7) Integral bell-spigot socket gives problems on rubber ring diameter outside of the pipe is in spec, inside of the pipe not controlled causing problems with rings

8) Pipe is more stretched at the socket so the wall thickness is there too low in case in in-mould socketing

Off-line solutions must have a belling machine for the right quality

The different PVC-O technologies V

Belling machines use biaxial orientation to secure wall thickness in the pipe (A)
Belling machines secure in inner sizes of the PVC-O pipe (B)

A: Problem of the wall thickness: two solutions:
1. Biaxial oriented pipe: length orientation is released to thicken the pipe
2. Mono axial oriented pipe: pipe end is forced to shorten to get thicker pipe

Cooperation is important to get the right solutions in the market with the right testing procedures.
New: Rollepaal bends 22.5° / 45° / 90° with double or single socket; R=3.5D

2 types of machines
110 – 250 mm
250 – 630 mm

110 – 250 machine
22.5° / 45° / 90°
Up to PN 25

250 – 630 machine
22.5° / 45°
Up to `PN 16
in study: 90° and up to PN 25
PVC-O Bending solutions

- 90º
- 110 mm production Machine
- Double socket

- 45º
- 110 mm
- single socket

- 22.5º
- 110 mm
- Double socket
PVC-O RBlue coupler solutions

New: Rollepaal coupler and repair couplers, Length is flexible

Recently a company came with reducers, but they are not according PVC-O standards having one MRS value for the part! Their reducers have different MRS values in one part.
Conclusions

1) PVC-O is a solution that is gaining interest globally and more installations will come.

2) The two technology principles, off line and in line, can both make good PVC-O pipe.

3) In Line technology on PVC-O has to consider larger sizes.

4) Off Line technology has to assure that the wall thickness of the pipe is controlled all the time to overcome quality issues.

5) Testing methods must be fixed in a standard for bell – spigot assemblies and for fittings and couplers.
Thanks and hope to see you soon