SAPPMA

southern african plastic pipe manufacturers association

WEBINAR VI

July 2021

22-07-2021

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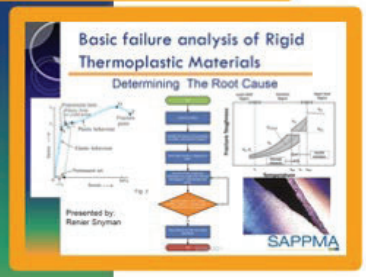
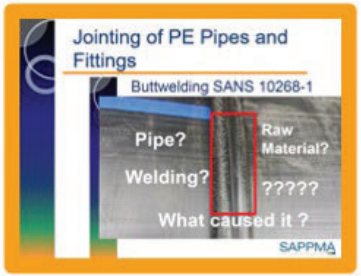
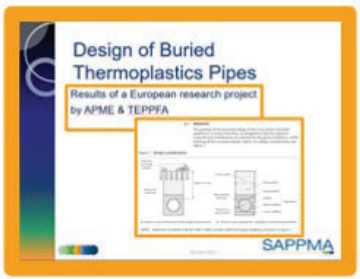
SAPPMA Webinar I to V on SAPPMA Web site

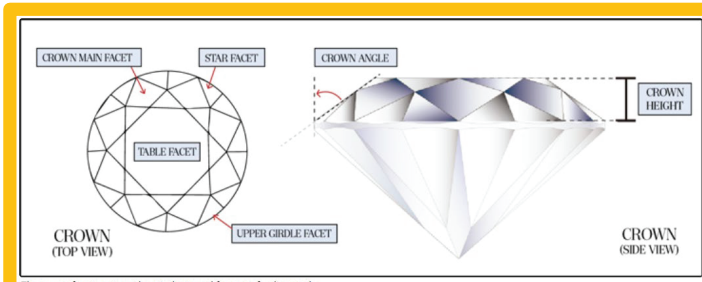






A diamond remains a gem

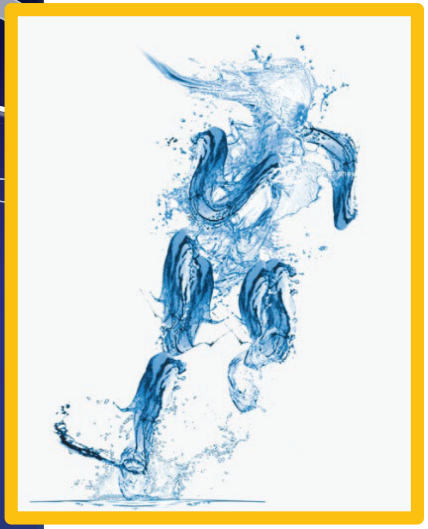
A facet is a flat surface on the geometric shape of the diamond



The crown facets acts as the windows and frames of a diamond

Which facet makes it shine?

It all works together



The pavilion of a diamond redirects light back to the observer and the wearer

How you go about it

A lot of what happens internal

Turns it into a lasting treasure, or not

Gets revealed and reflected outwards

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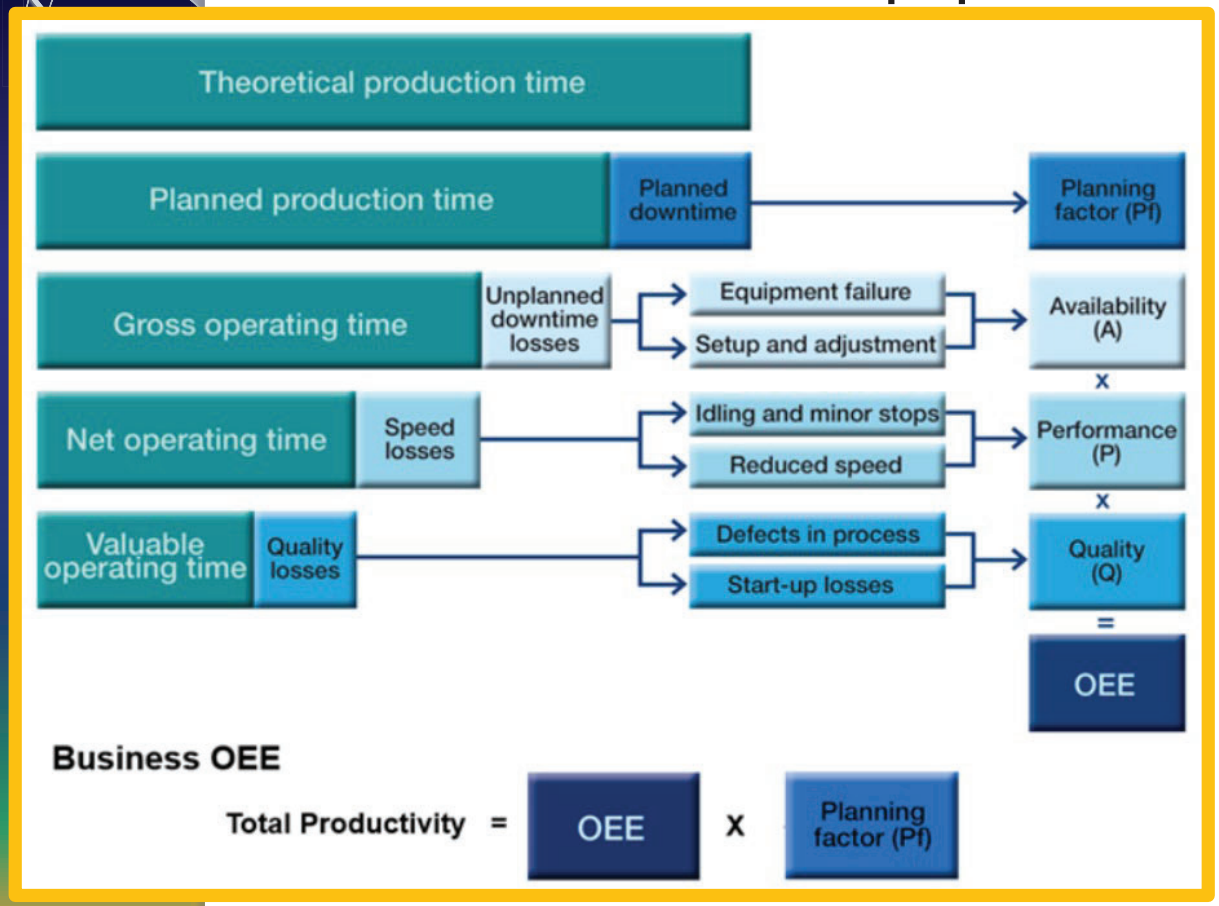
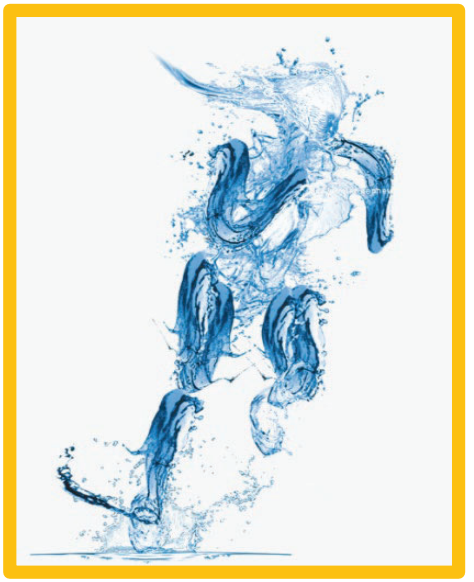
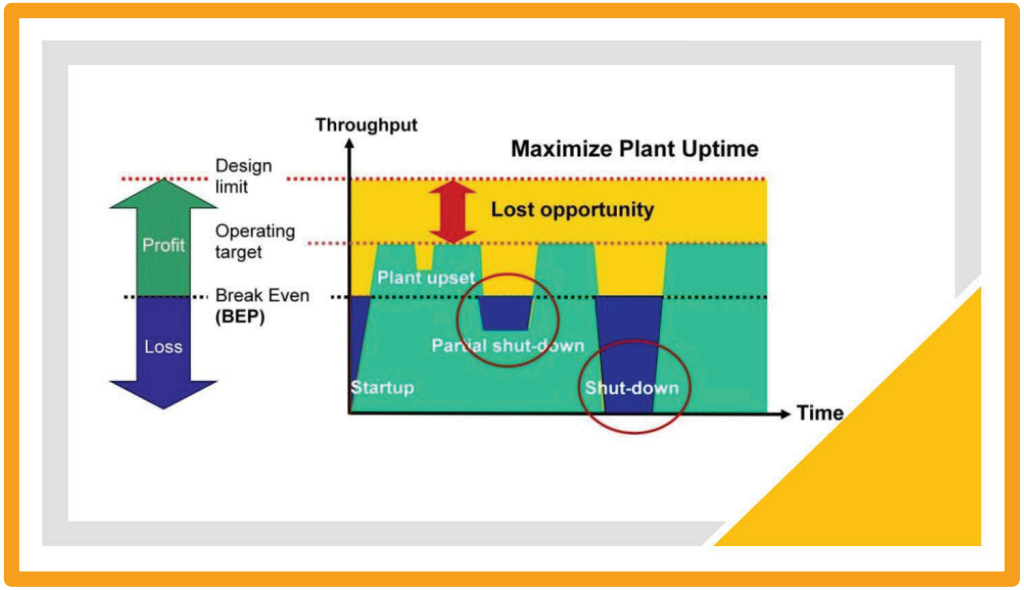
Your output is another's input
Overall Equipment Effectiveness





Above & Below / Risk & Opportunity

What happens above and below have a massive influence on the outcome



Now (QMS) Quality Management, (TCOQ) Total Cost of Quality and Risk Management make a lot more sense

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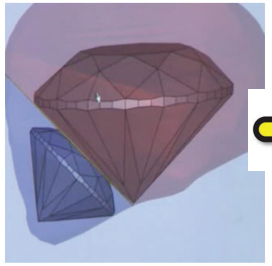
You will not know the result of your effort in the next few years !

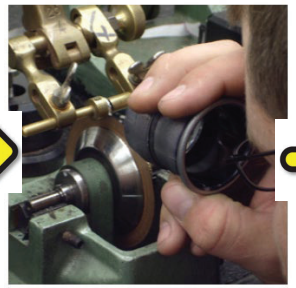
What will you do with the time on your hands ?

DIAMOND MARKING
THE FIRST ARCHITECT



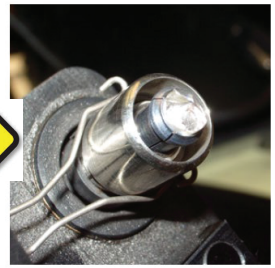
Planning

SAWING



Cutting

BRUTING AND GIRDLING
THE FIRST STAGE

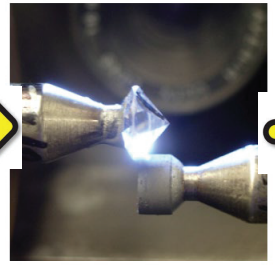


Rough Rounding

BLOCKING
THE SECOND ARCHITECT

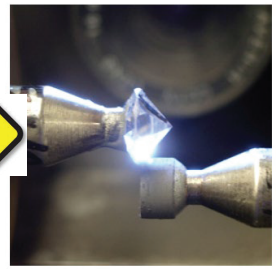
$$\frac{\text{Top}}{\text{Bottom}} \text{ x } \frac{\text{Primary}}{\text{Secondary}} = \text{Facets}$$

BRUITING AND GIRDLING
THE SECOND STAGE



Final Rounding

BRILLIANTEERING
THE FINAL STAGE



Final Facets

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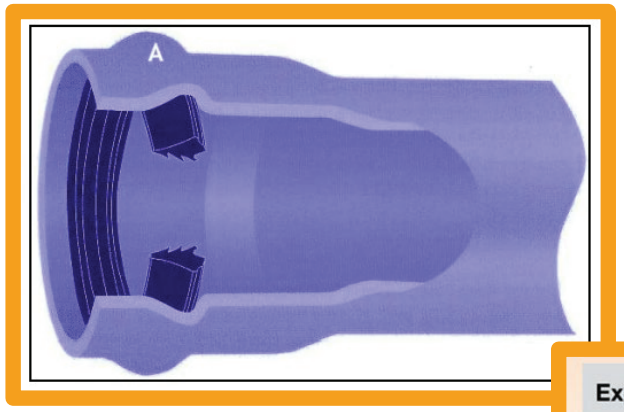

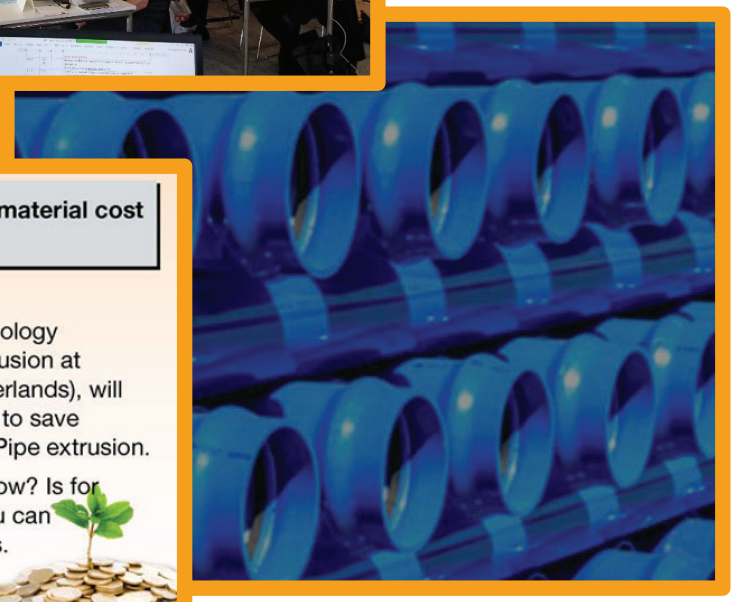

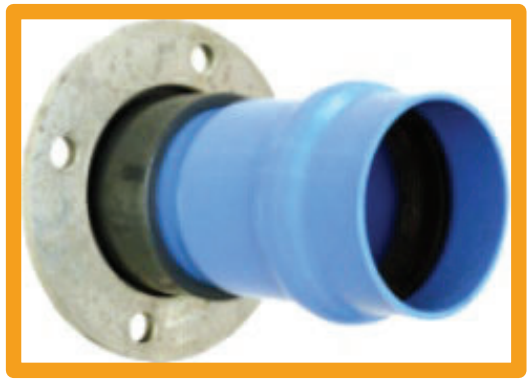

Exploring the possibilities to optimize material cost in Plastic Pipe extrusion.

Helmuth Rijnhart, Technology Manager PVC Pipe Extrusion at Rollepaal B.V (the Netherlands), will explore the possibilities to save material cost in Plastic Pipe extrusion.

Step 1: Where are we now? Is for free. From that base you can plan your improvements.

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Presenter

22 July 2021

rollepaal

Helmuth Rijnhart

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Saving Material in Plastic Pipe Production

Rollepaal the Netherlands

- Equipment for Plastic Pipe extrusion
- Est. 1962 in the Wavin group
- Independent since 2003
- Focus on PVC
- Technology leader
  - Extruder design
  - Die design
  - Cost Saving Solutions
    - Weight Saving & Process Optimizing
    - Direct Addition of CaCO3
    - Multilayer foamcore/recycled
    - PVC-O

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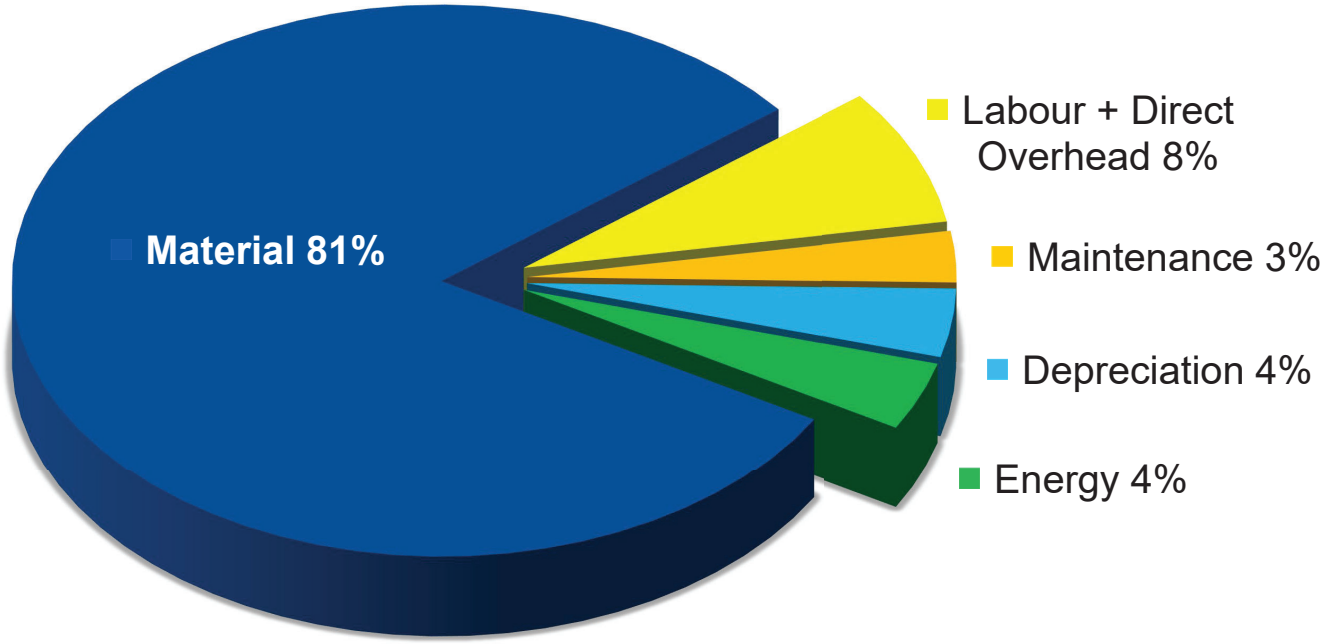
Why PVC?

- Proven solution for pipes for 70 years!
- Corrosion and Chemical resistant
- High Strength: 2,5x PE100 (PVC-O even 5x)
- Fossil content 50% compared to PE
- The possibility to improve (formulation)

Typical Cost Breakdown of Plastic Pipe



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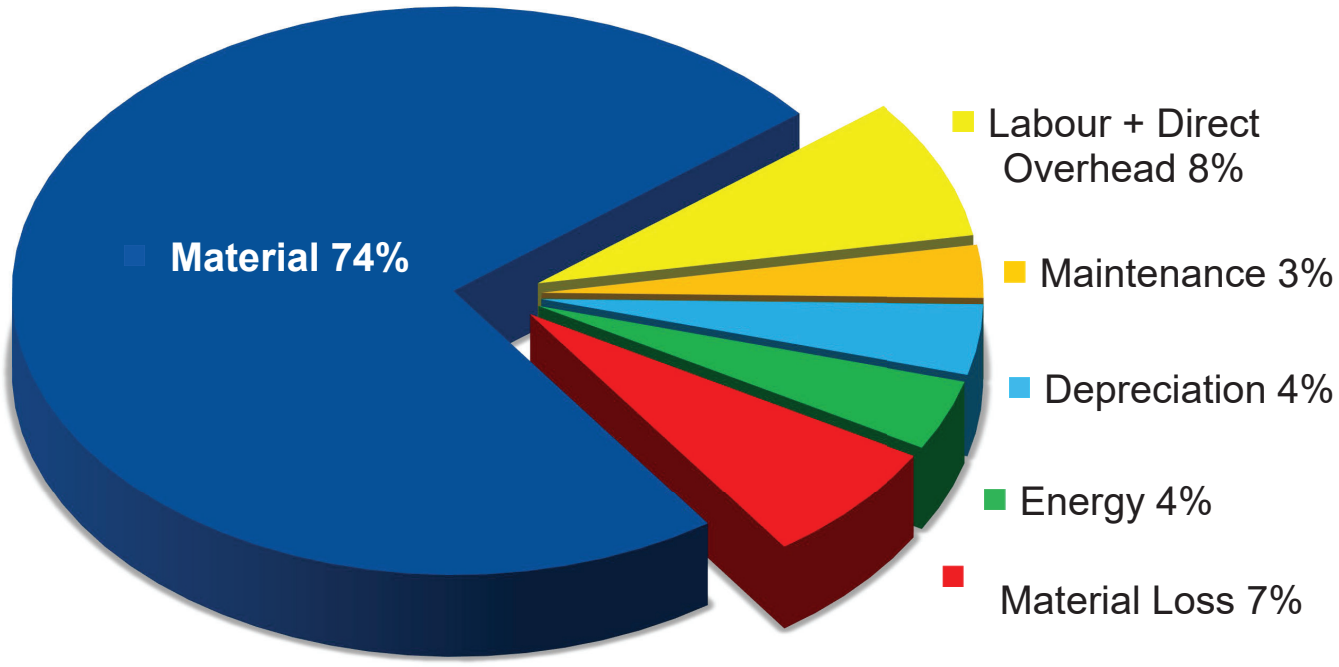

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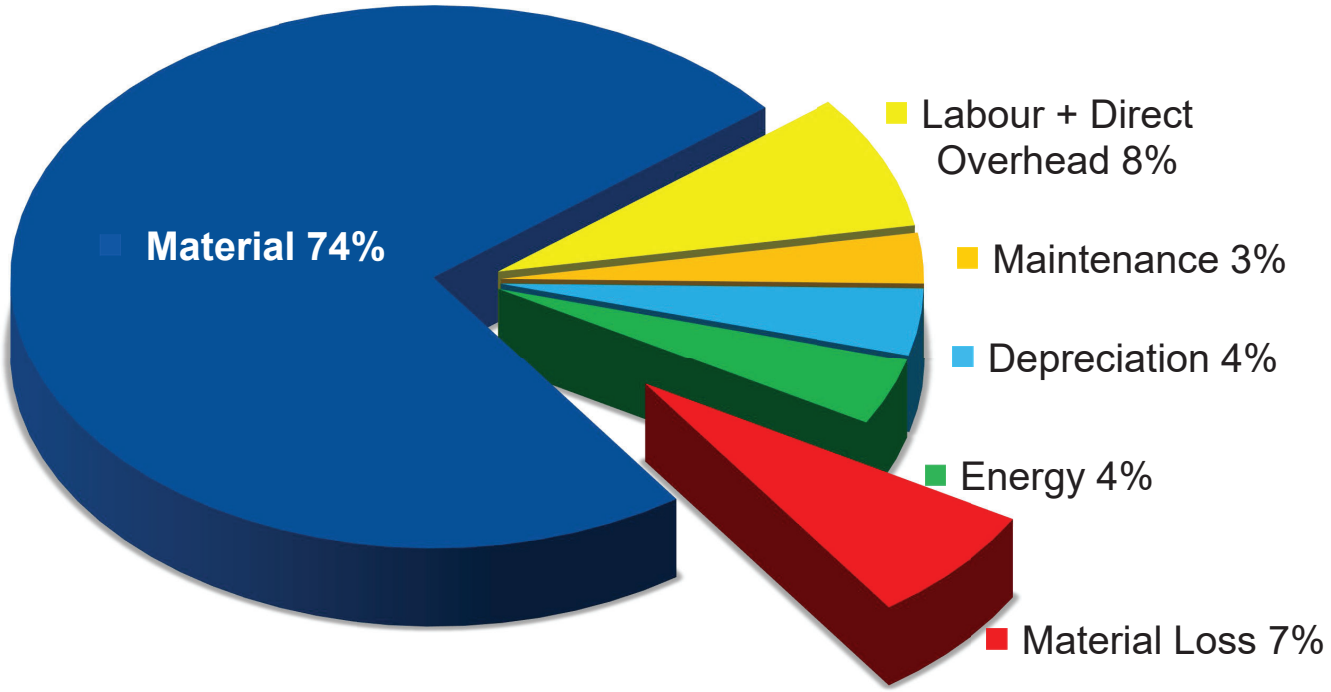
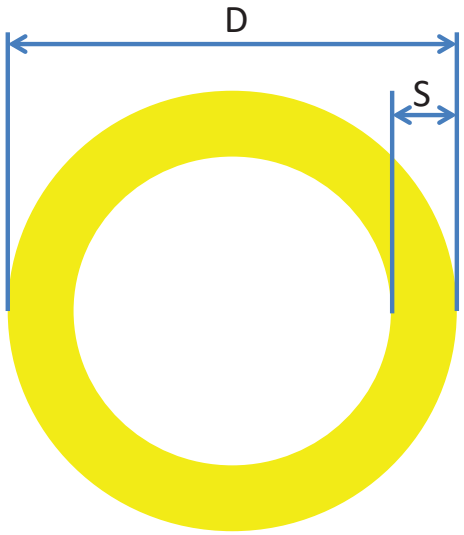


Material Loss

- Start and Stop scrap
- Reject pipe during production
- Overweight of the pipe

Overweight is 100% loss. It can not be recycled!

Definition of Overweight



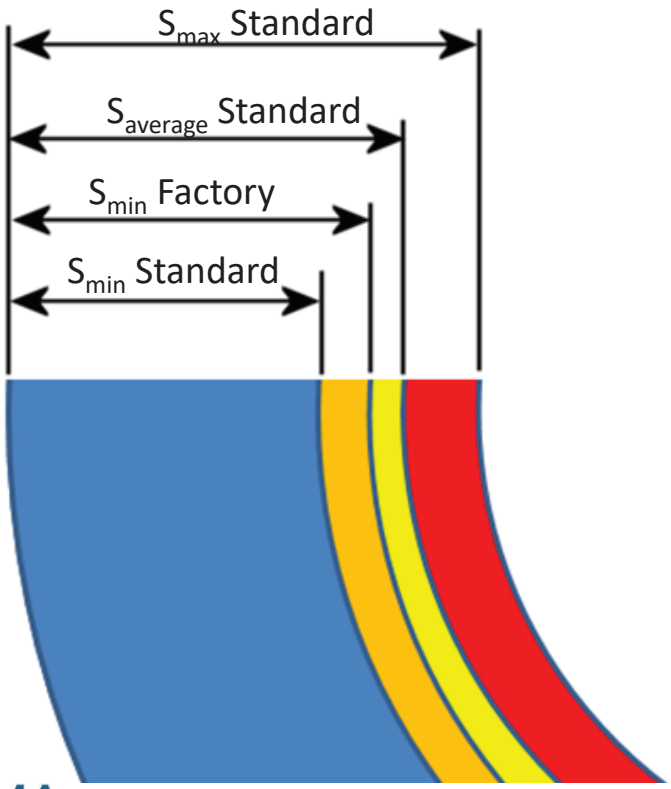
Overweight is the weight, higher than the theoretical minimum weight, defined by the minimum Diameter and the minimum Wall Thickness

In general:

Tolerance on Diameter	0,3-0,6%
Tolerance on Wall Thickness	5- 15%

Conclusion: Wall Thickness is the real issue!

Definition of Overweight



Always calculate and report overweight from S_{min} according to the Standard,

even if your manufacturing standard is different.

We call this: Real Overweight

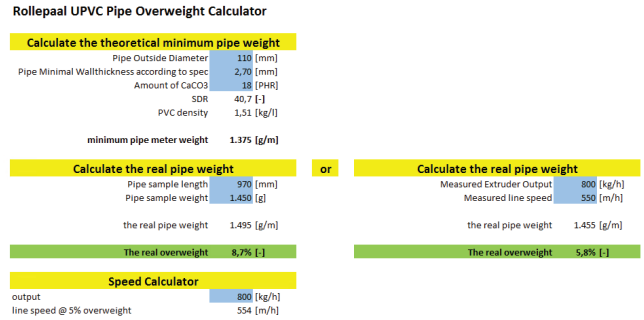
Step 1: Where are we now?

1. Calculate the minimum weight from Diameter, Min. Wallthickness and PHR of CaCO3: Wmin

2. Measure the real meterweight of the pipe: Wreal
   - Cut the pipe, Weigh the Pipe, Devide by length
   - Or: measure real output and line speed

3. Calculate overweight: Wreal/Wmin – 1

Ask for your free overweight calculator from Rollepaal!



Rollepaal UPVC Pipe Overweight Calculator

Calculate the theoretical minimum pipe weight		
Pipe Outside Diameter	110	[mm]
Pipe Minimal Wallthickness according to spec	2,70	[mm]
Amount of CaCO3	18	[PHR]
SDR	40,7	[-]
PVC density	1,51	[kg/l]
minimum pipe meter weight	**1.375**	**[g/m]**

Calculate the real pipe weight		
Pipe sample length	970	[mm]
Pipe sample weight	1.450	[g]
the real pipe weight	1.495	[g/m]
The real overweight	**8,7%**	**[-]**

or

Calculate the real pipe weight		
Measured Extruder Output	800	[kg/h]
Measured line speed	550	[m/h]
the real pipe weight	1.455	[g/m]
The real overweight	**5,8%**	**[-]**

Speed Calculator		
output	800	[kg/h]
line speed @ 5% overweight	554	[m/h]

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Speed Calculator

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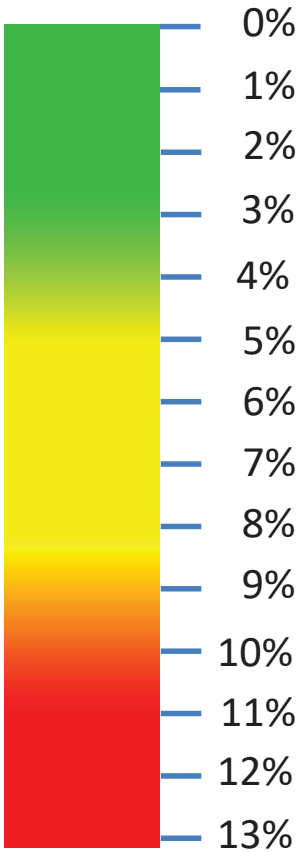
Real Overweight: what is good?



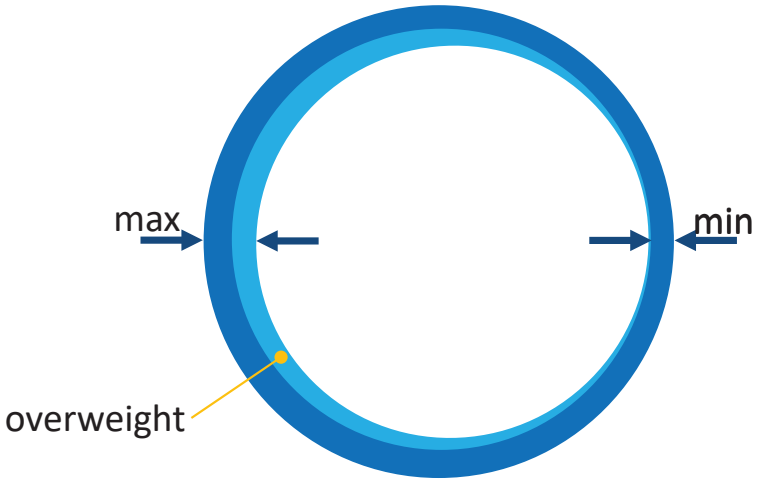
< 3%: Excellent
>10%: Serious Challange

The total value of Material per year is 10-20 times the value of the extrusion line!

Successful Investment in Reducing Overweight will have a very short Payback Time!

Reasons for Overweight

Eccentricity of the pipe wall



Normal Eccentricity

cause:

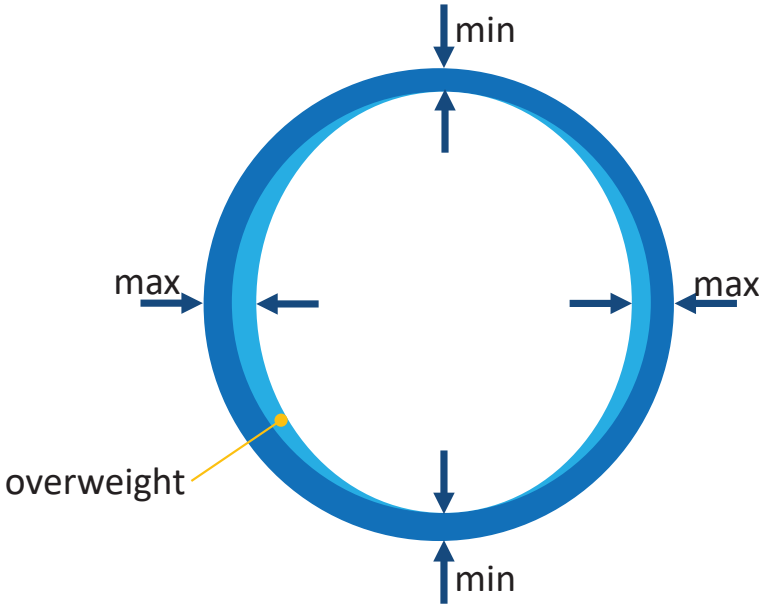
- Bad centering of the die head
- Cold segment in die head

solution:

- Manual centering of die head
- Establish uniform die temperatures

Reasons for Overweight

Eccentricity of the pipe wall



Double Eccentricity

cause:

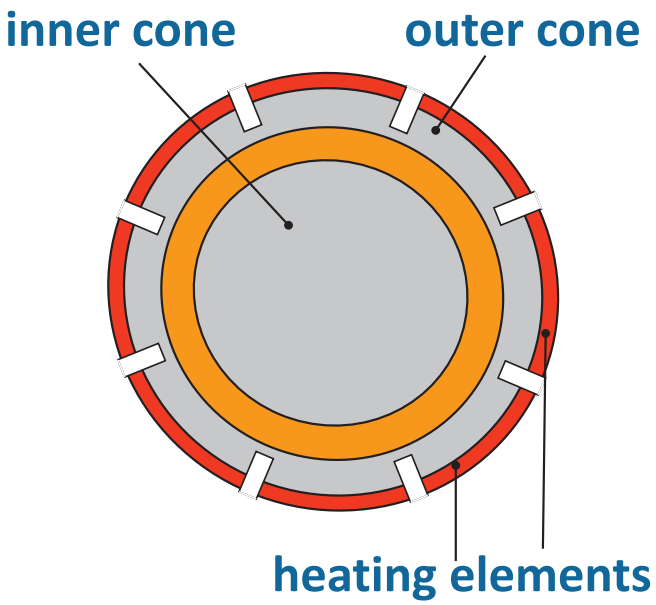
- Formulation
- Screw design
- Unequal die temperatures

solution:

- Establish uniform die temperatures
- Optimize formulation and/or screw design
- Apply Thermal Centering die tooling

Reasons for Overweight

Thermal Centering tooling



Higher Die temperature

↓

Lower friction

↓

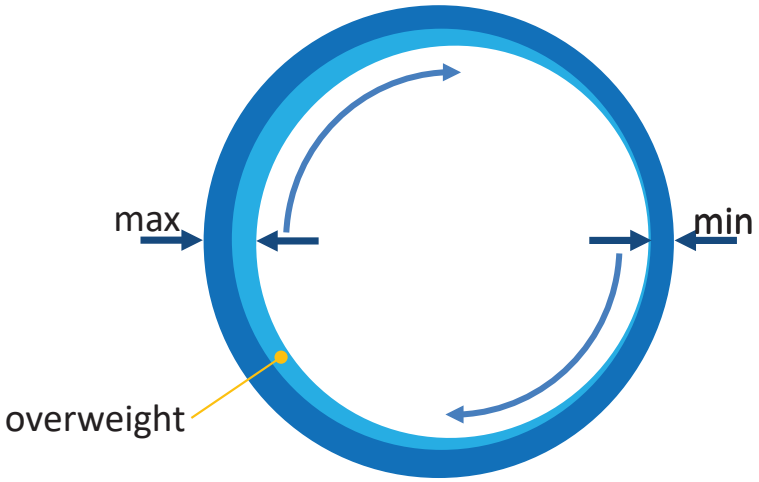
Higher flow speed

↓

Increase in wall thickness

Reasons for Overweight

Eccentricity of the pipe wall



Continuous Variations in Eccentricity

cause:

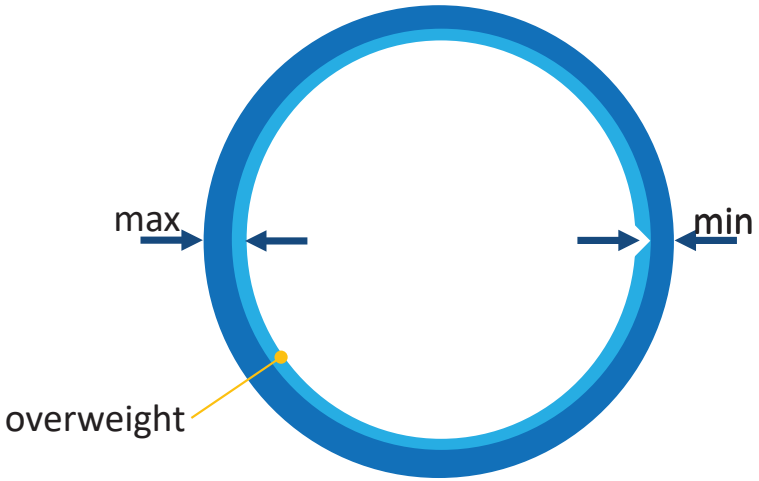
- Slip/Stick of PVC in Die Head
- Formulation
- Screw design

solution:

- Die Head surface coating
- Formulation
- Screw design

Reasons for Overweight

Marks in the pipe



Thin line / Scratch

cause:

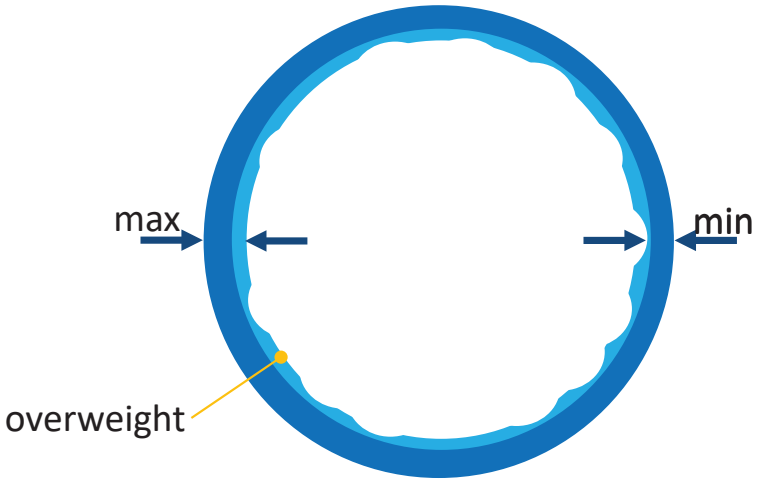
- Surface defects in die head
- Plate out in die head
- Plate out on tooling

solution:

- Die Head design
- Die Head maintenance
- Formulation

Reasons for Overweight

Marks in the pipe



Roughness (Waviness)

cause:

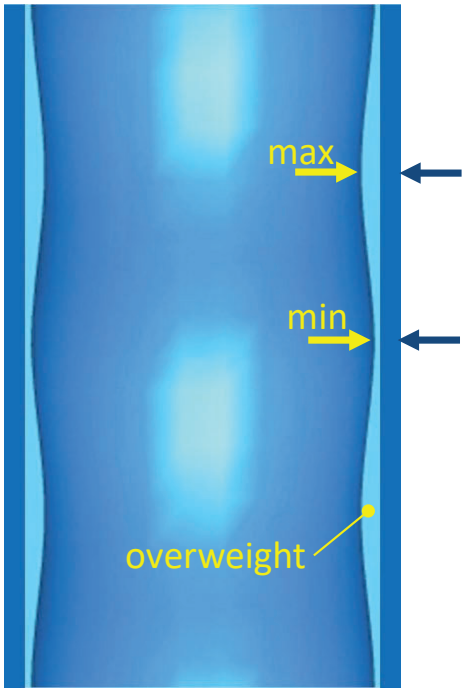
- Formulation
- Processing
- Die Head volume
- Die Head compression
- Output

solution:

- Optimize process
- Apply proper die head

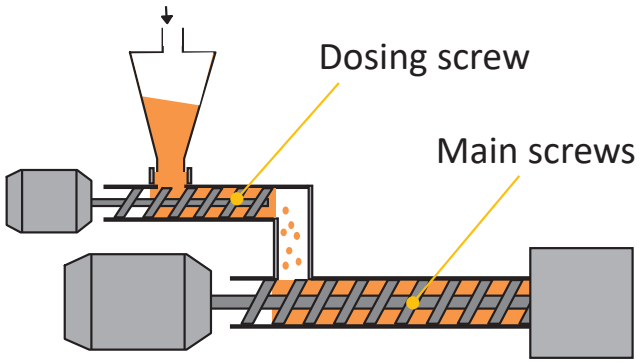
Reasons for Overweight

Variations in Wall thickness over time



- Variations in Bulk Density of dry blend (PVC)
- Variations in formulation from one batch to another (PVC)
- Variations in Mixing conditions (PVC)
- Segregation of dry blend during storage and conveying (PVC/CaCO3)
- Variations in Ambient Conditions.

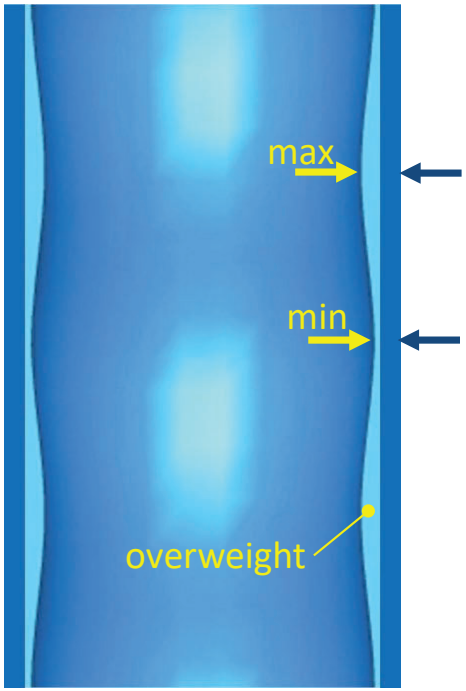
Modern PVC extruders: starve feed

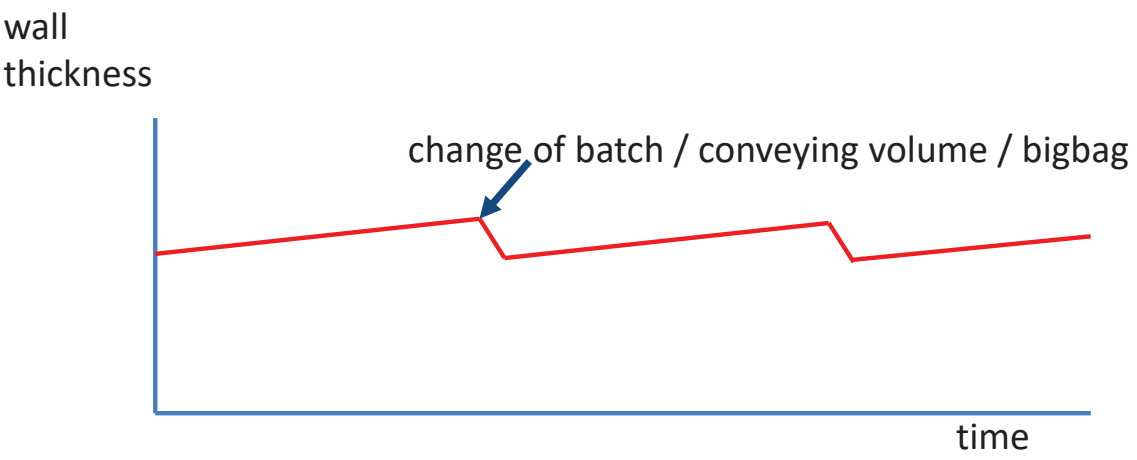


- Output depends on dosing screw speed, Bulk Density and Pourability
- Output is independent of main screws speed

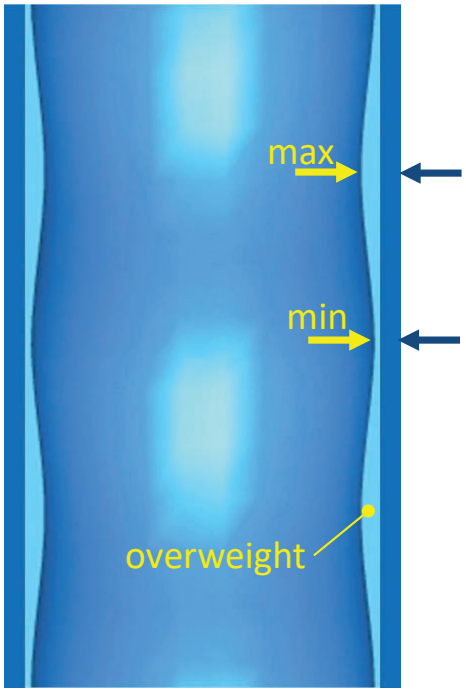
Variations in Wall thickness over time

- Variations in Bulk Density of dry blend (PVC)

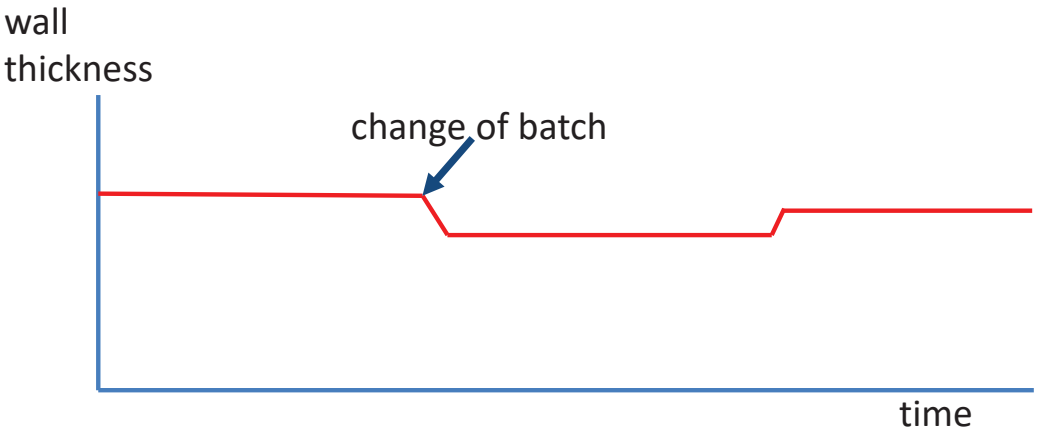




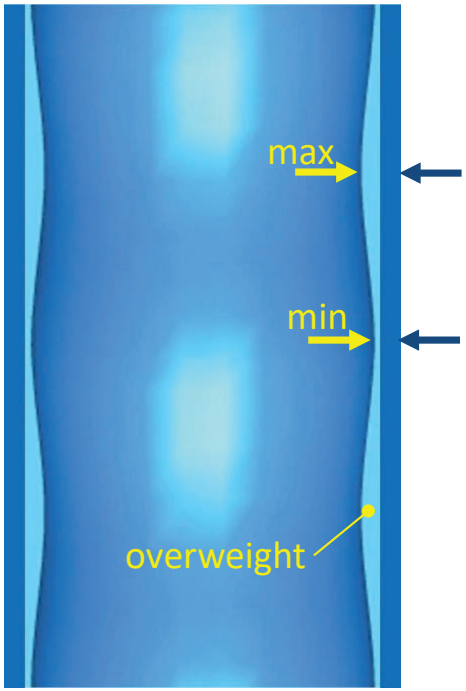
Variations in Wall thickness over time



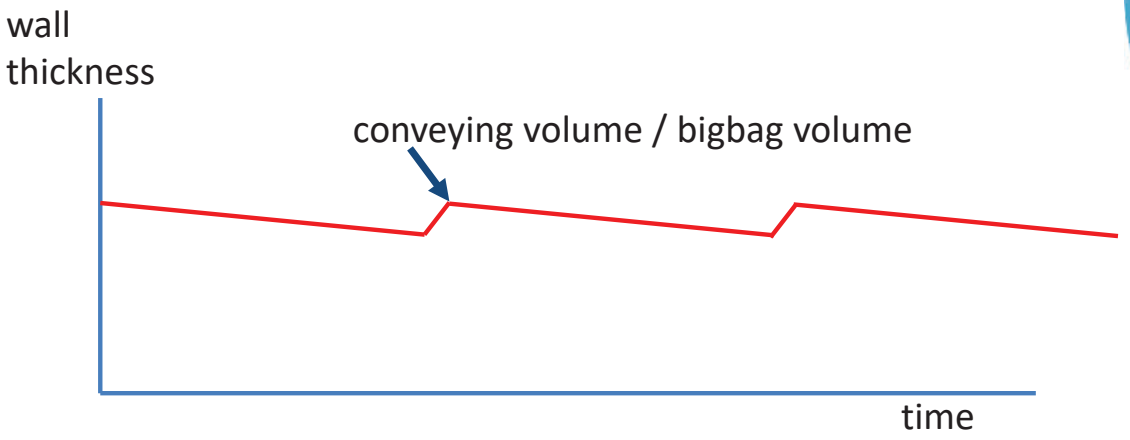
- Variations in formulation or mixing conditions from one batch to another (PVC)



Variations in Wall thickness over time

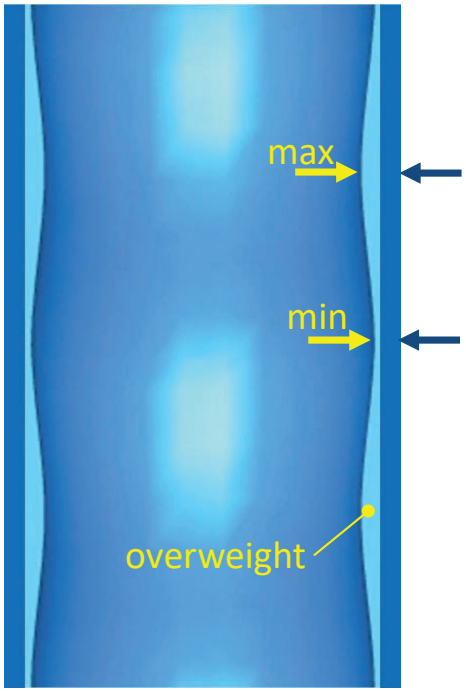


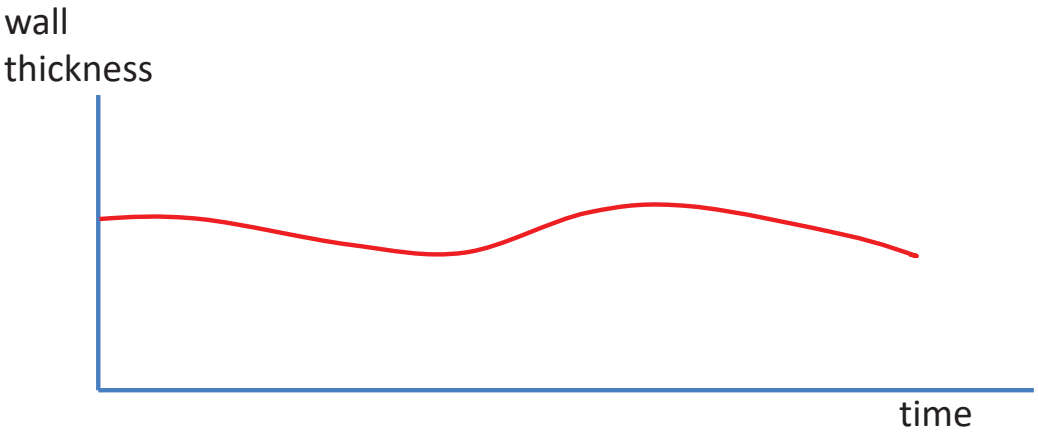
- Segregation of dry blend during storage and conveying (PVC/CaCO3)



Variations in Wall thickness over time

- Variations in ambient conditions





Reasons for Overweight

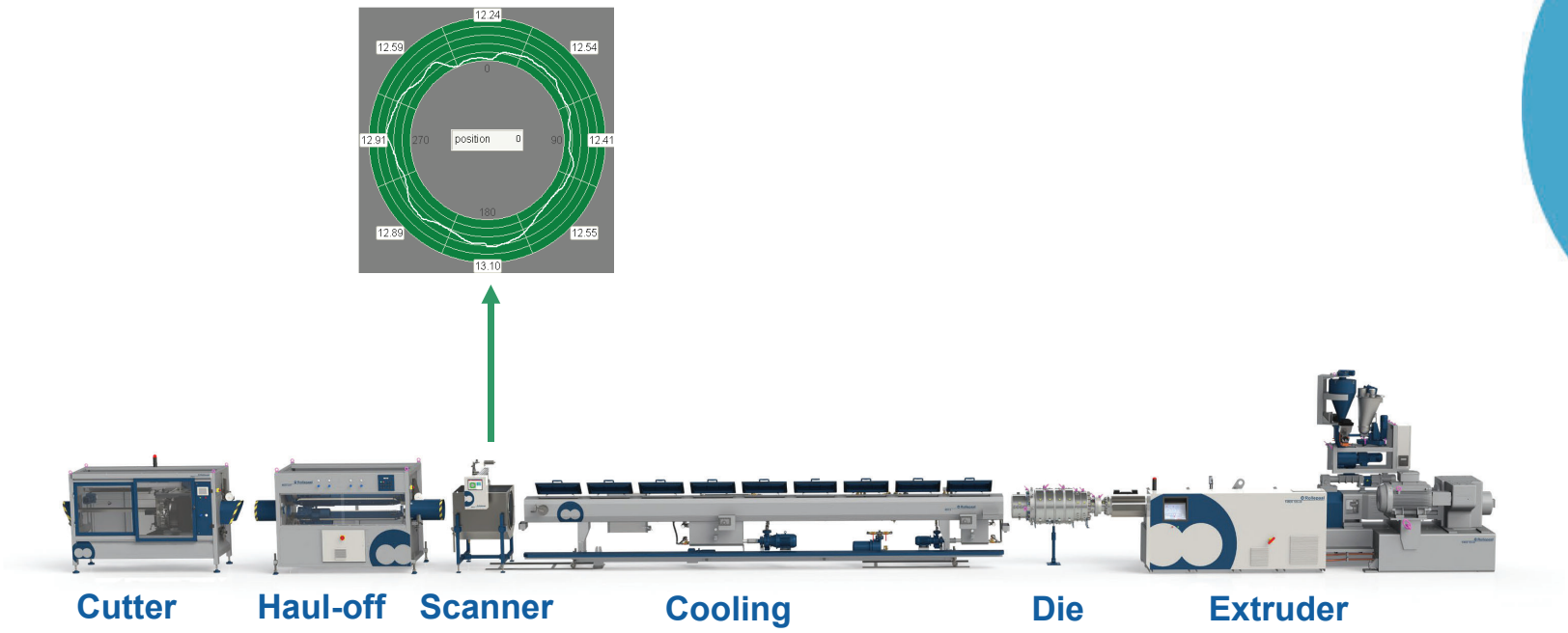
- **Eccentricity of the pipe wall**
  - sub optimal centering of the die
  - non-uniform flow through the die
    - due to die design
    - due to temperature differences
    - due to formulation and/or screw design
    - due to surface defects on the flow-line
    - due to wear and tear
    - due to wrong choice surface treatment in relation to the plastic type

- **Marks in the pipe**
  - thin lines, caused by damages or plate-out
  - roughness, waviness marks (PVC)

- **Variation in overall wall thickness over time**
  - Variations in Bulk Density of dry blend (PVC)
  - Variations in formulation from one batch to another (PVC)
  - Variations in Mixing conditions (PVC)
  - Segregation of dry blend during storage and conveying (PVC/CaCO3)
  - Variations in Ambient Conditions.

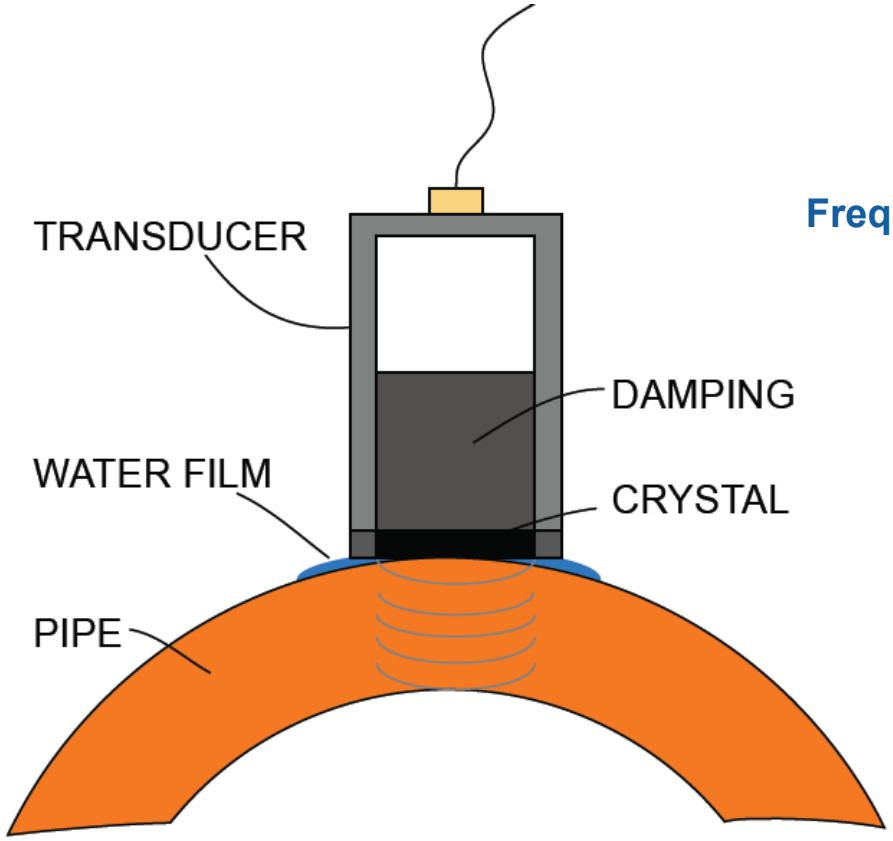
General Policy:
Pipe Manufacturers avoid producing off spec pipe by setting the wall thickness to a safe value.

2: Measure Pipe Wall



Measure Pipe Wall

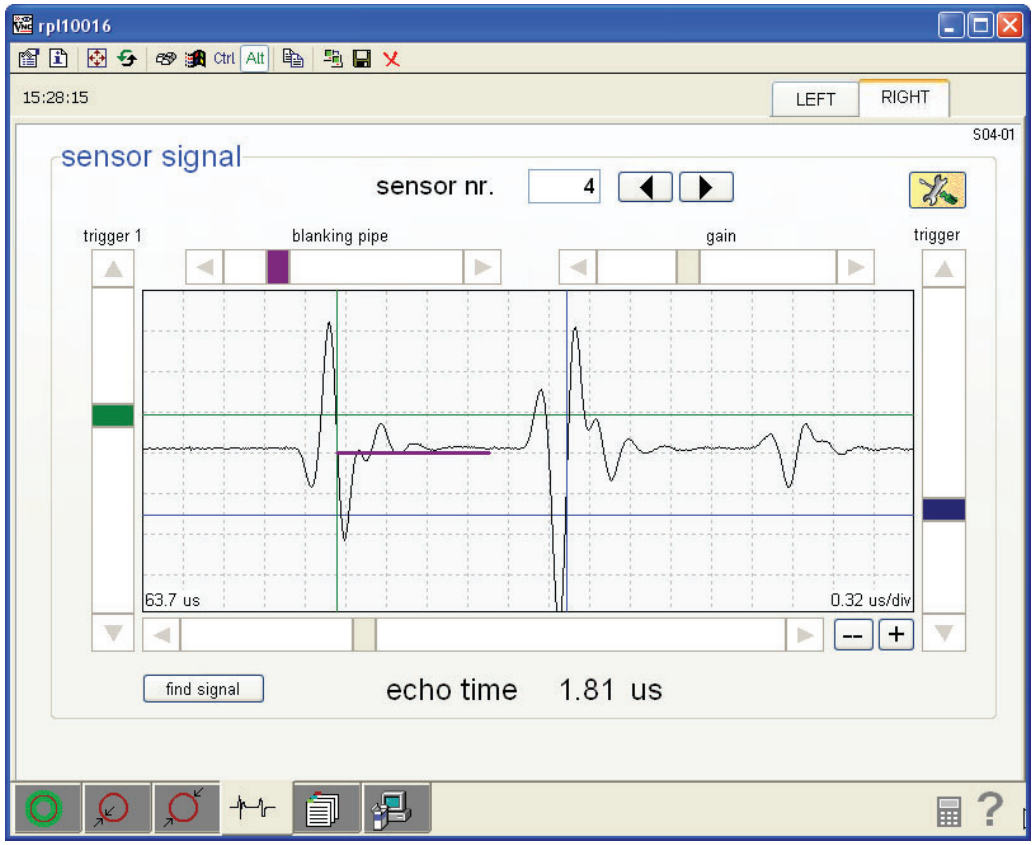
Ultrasound Scanning Technology



Frequency 1-10 MHz

Measure Pipe Wall

Ultrasound Scanning Technology



Measure Pipe Wall

Ultrasound Scanning Technology

multiple sensors

bath filled with water

diameter measurement

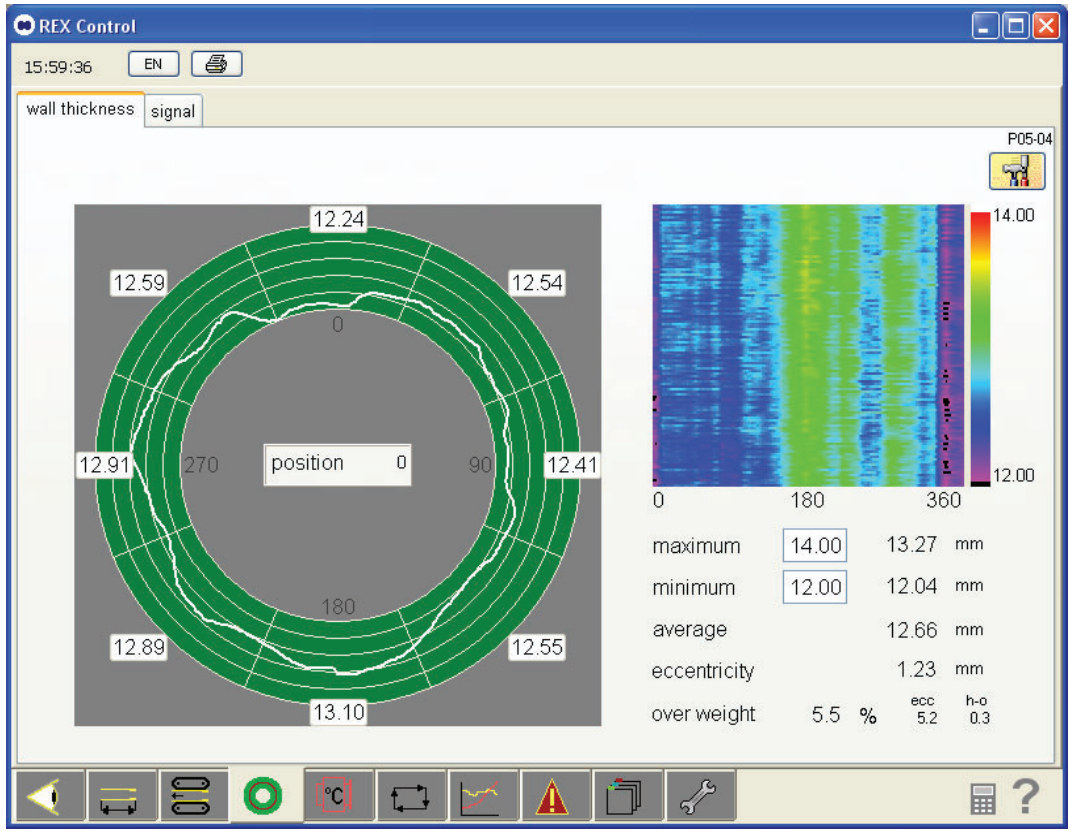
single sensor

no water bath

no diameter measurement

Measure Pipe Wall

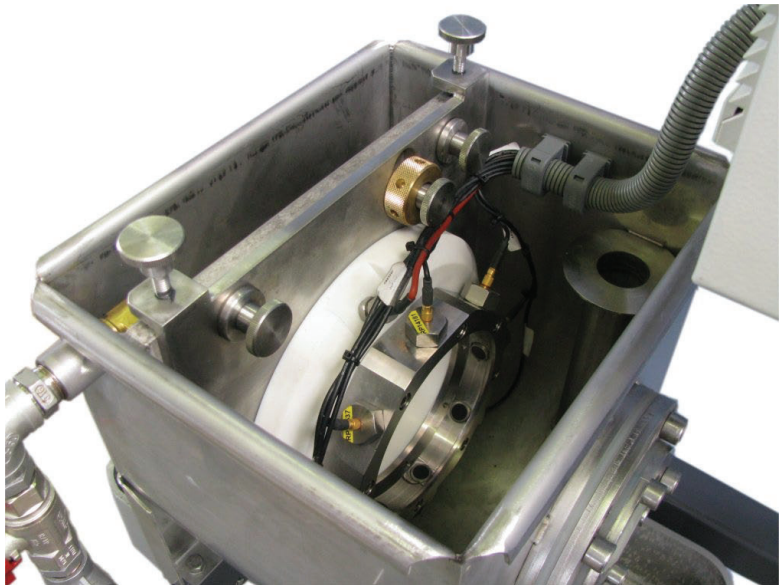
Ultrasound Scanning Technology



Measure Pipe Wall

Ultrasound Scanning Technology

Static scanner RCS

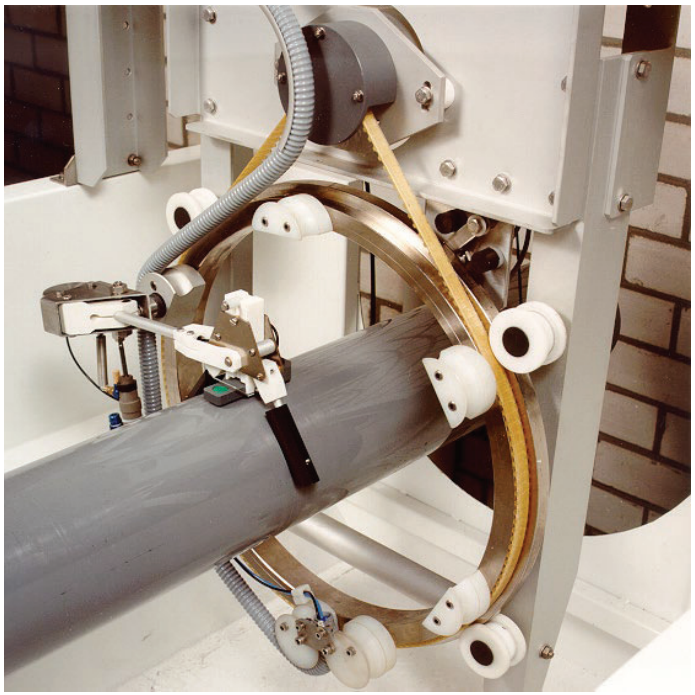


RCS 2	10-63 mm
RCS 4	20-125 mm
RCS 8	20-250 mm
RCS 16	110-400 mm

Measure Pipe Wall

Ultrasound Scanning Technology

Rotating scanner RRS



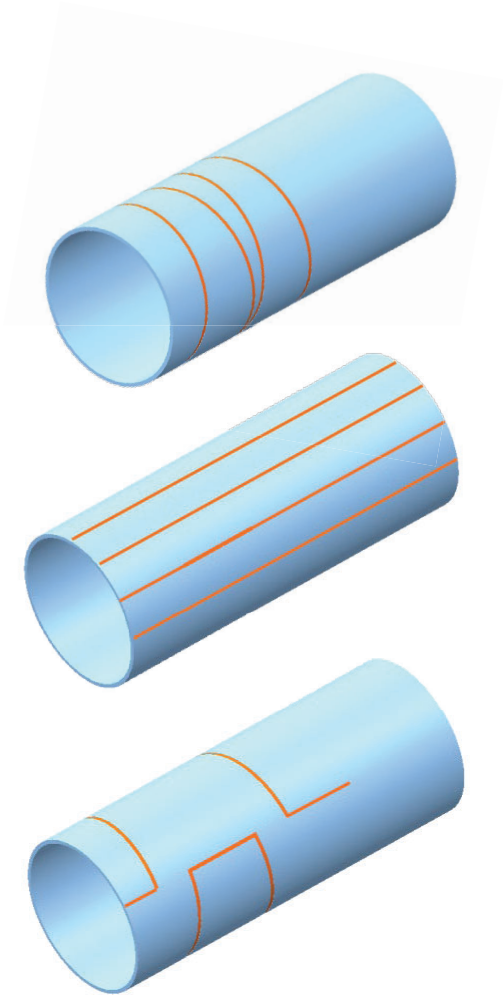
RRS 8	63 - 250 mm
RRS 16	110 - 450 mm
RRS 24	110 - 630 mm
RRS 30	160 – 800 mm
RRS 48	160 - 1200 mm

Measure Pipe Wall

Rotating Scanner gives high resolution information in circumference of pipe

Static Scanner gives high resolution information in length of pipe

The intermitting rotating scanner will give information in both circumference and length direction.



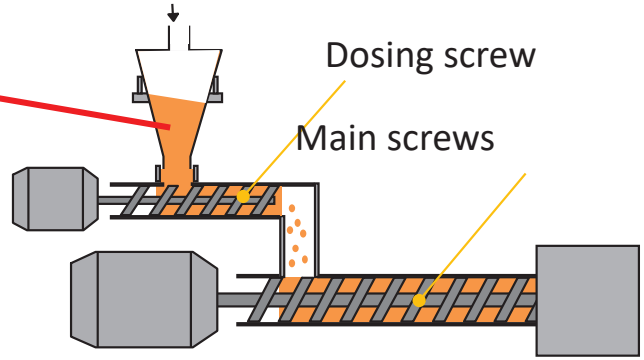
Think about the idea to have one intermitting rotating scanner in your factory that helps you to evaluate your process in different lines.

3: Measure Real Output

Rollepaal RGS

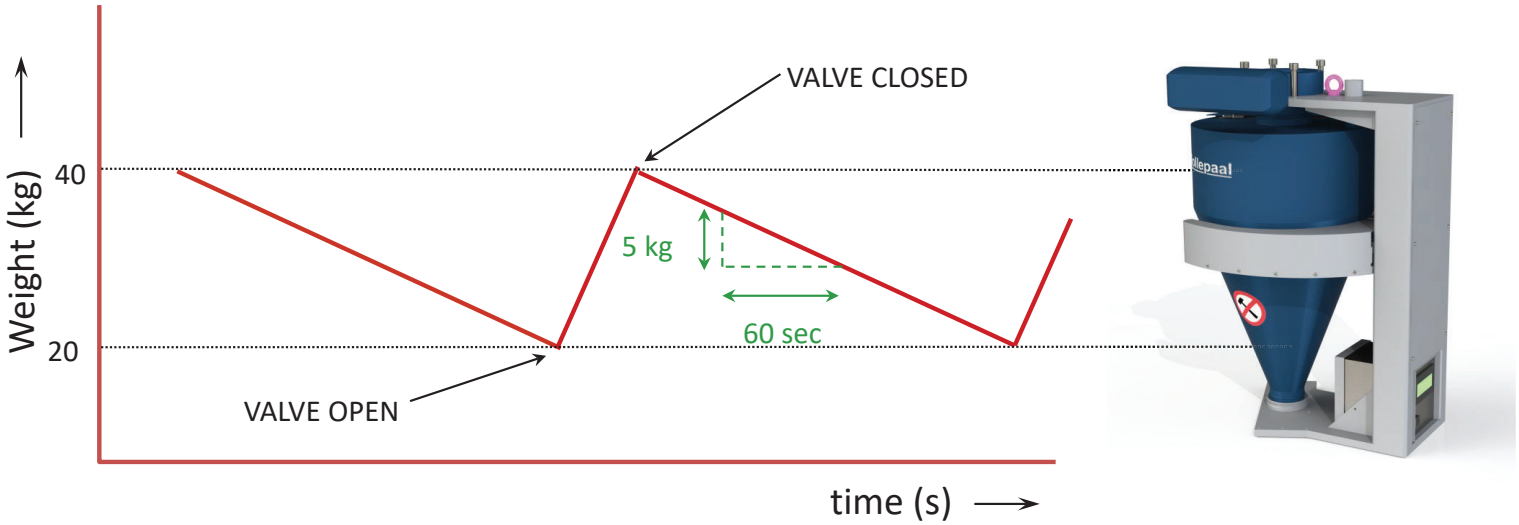
Gravimetric Loss in Weight system

- Detection of variations in Throughput



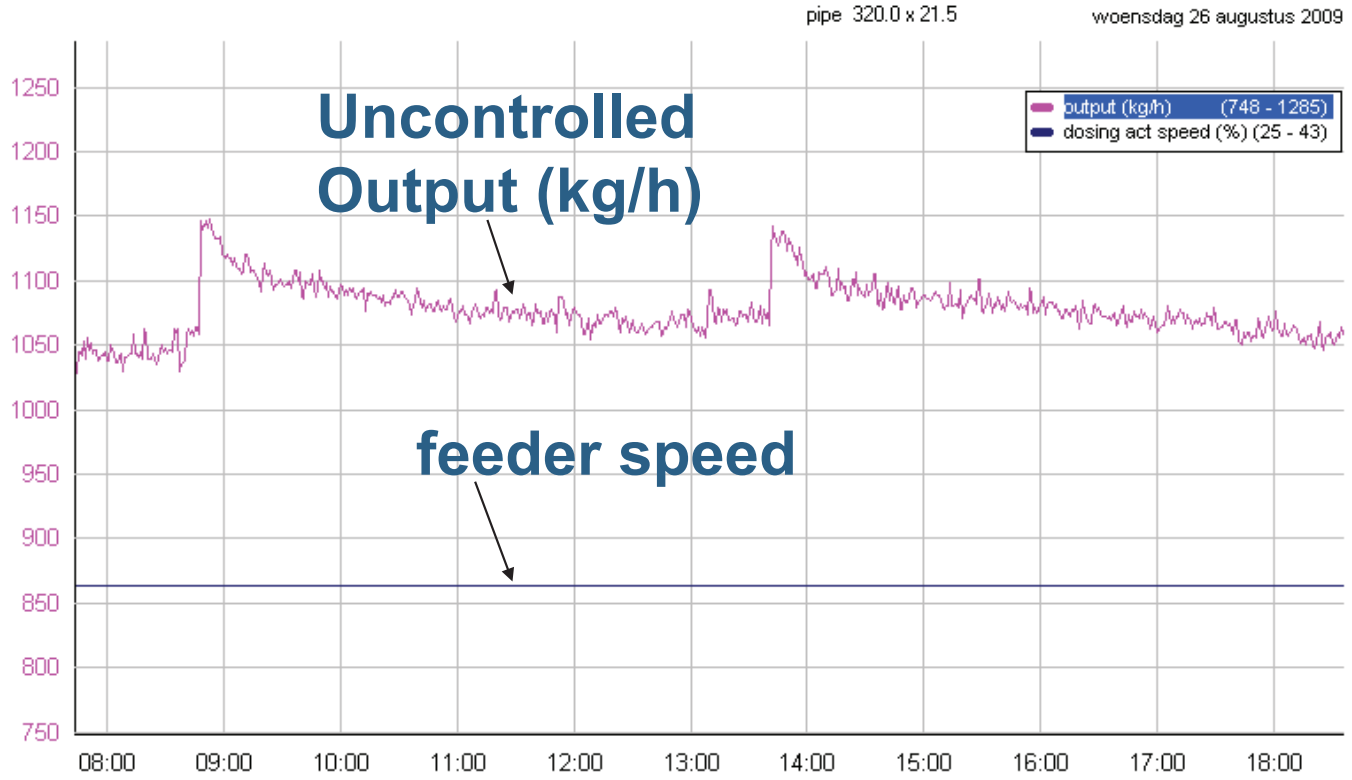
Measure Real Output

Loss-in-weight operation

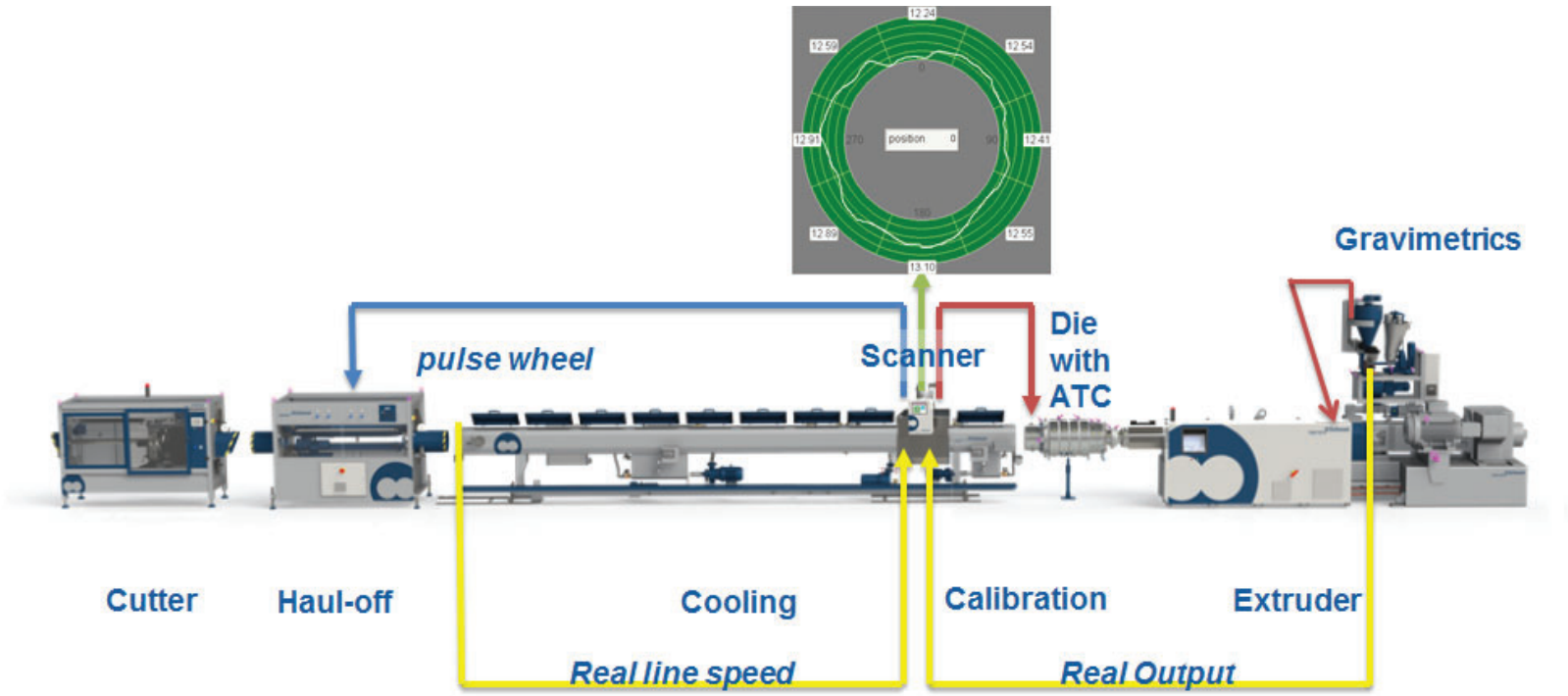


Measure Real Output

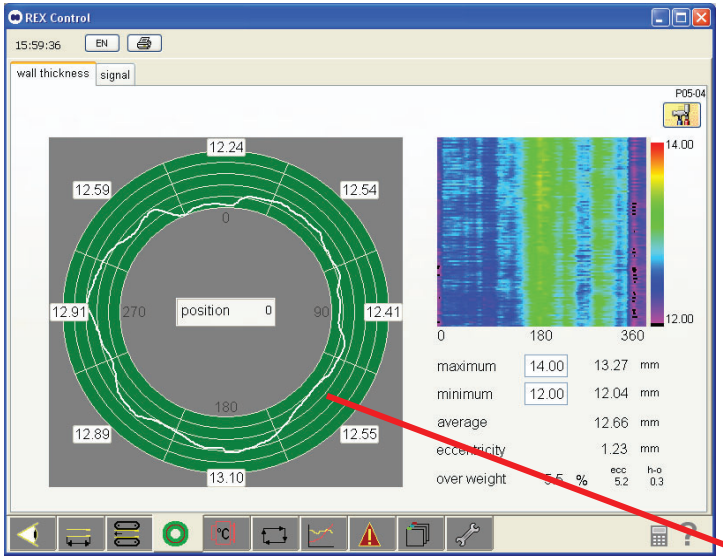
Trend data



4: Continuous line control loops



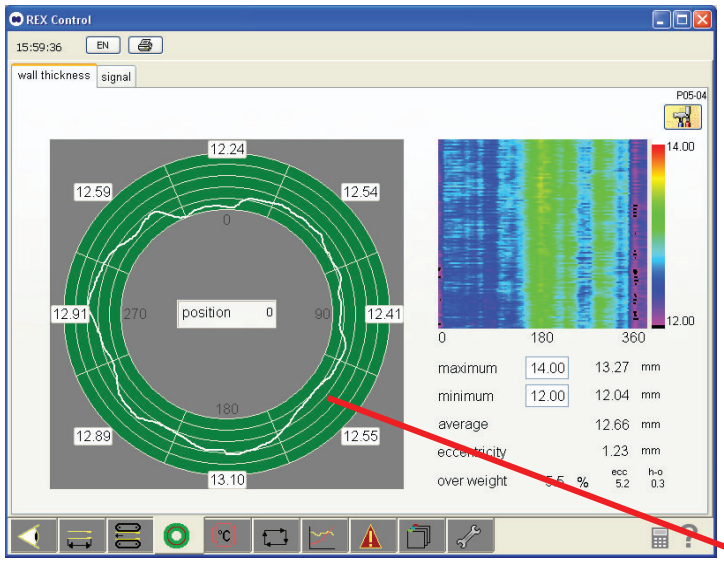
Continuous line control loops



Control Wall Thickness

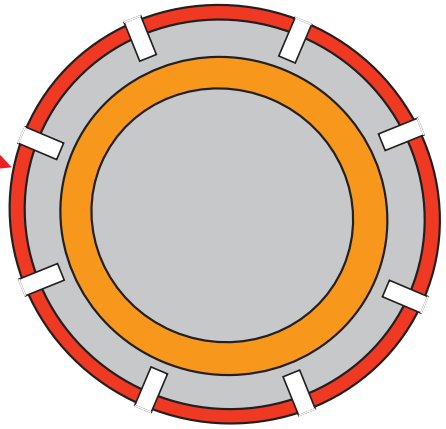
- Measure Minimum Wall Thickness
- Measure Line speed
- Automatic adjust setpoint Hauloff

Continuous line control loops



Automatic Thermal Centering

- Measure Wall Thickness
- Control Centering Temperatures
- Automatic Optimize Wall Thickness Distribution

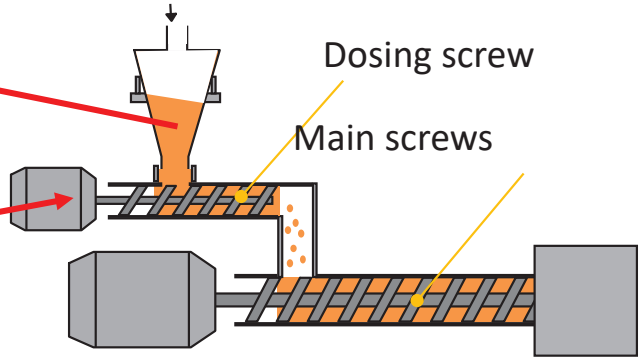


Continuous line control loops

Gravimetric Loss in Weight system

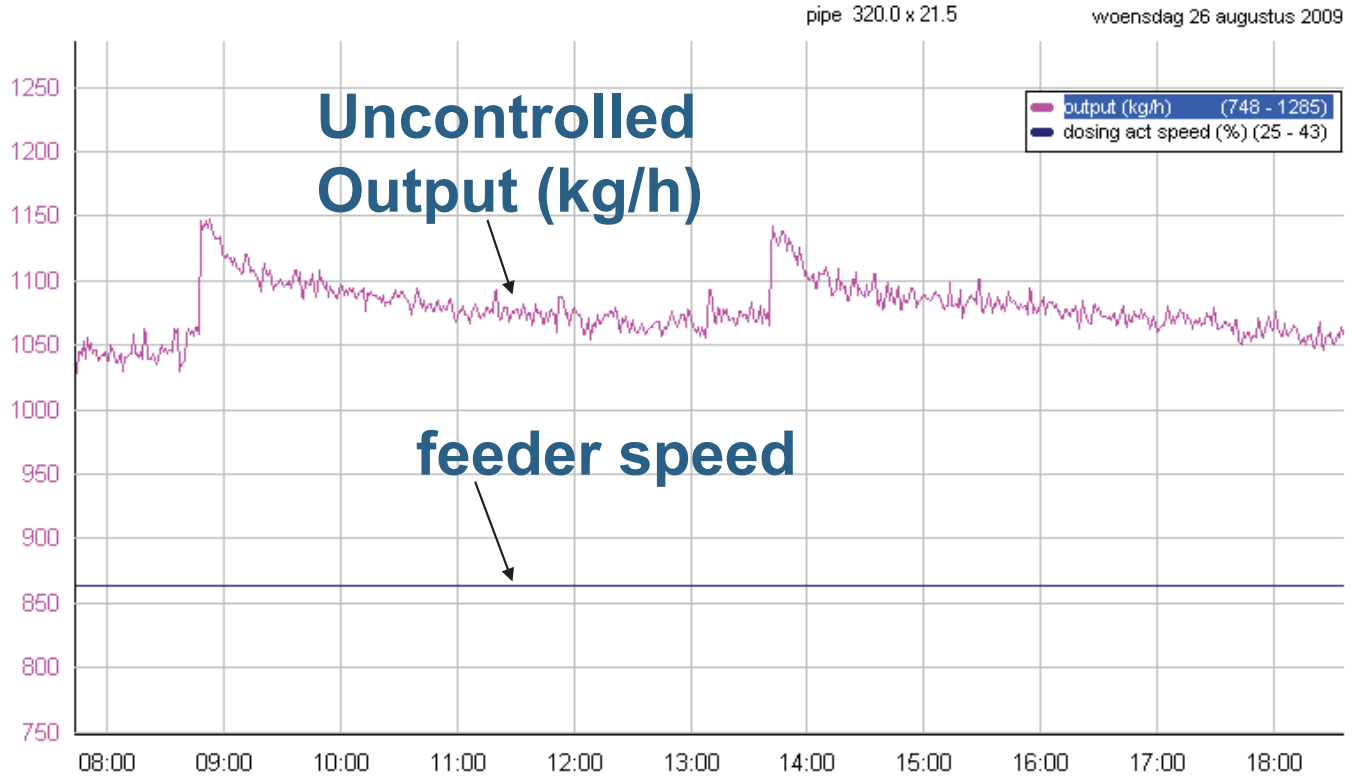
- Measure real output
- Control Dosing speed
- Create Constant Output

Rollepaal RGS



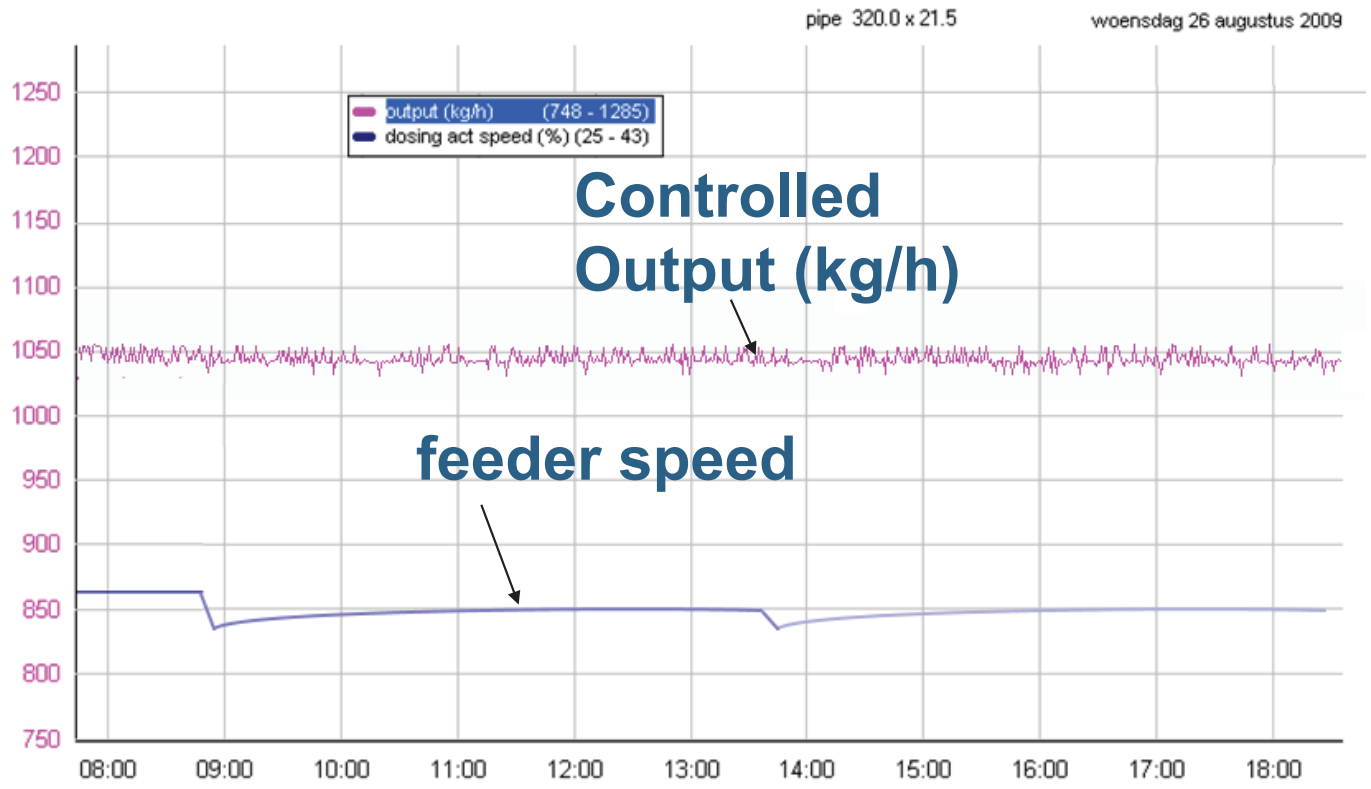
Measure Real Throughput

Trend data



Measure Real Throughput

Trend data



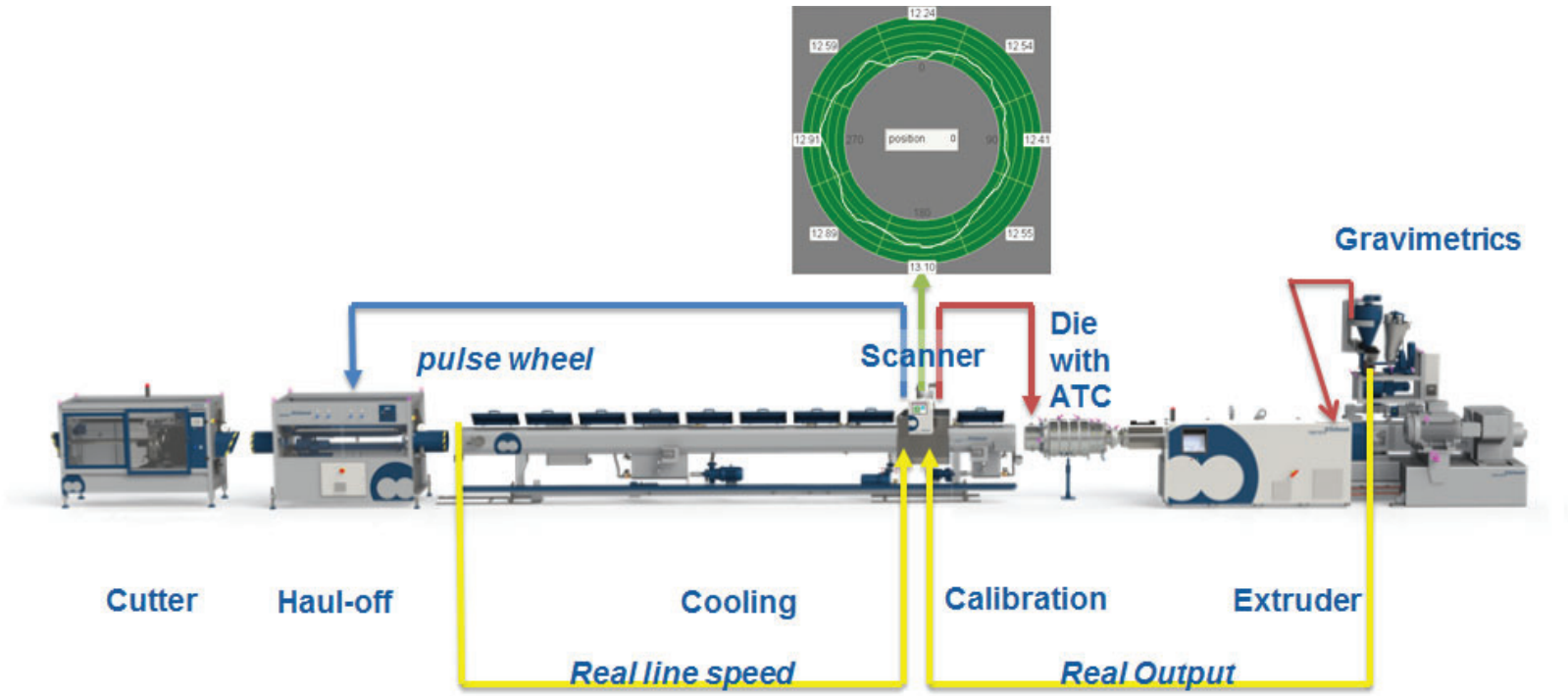
Continuous line control loops

Rollepaal RGS

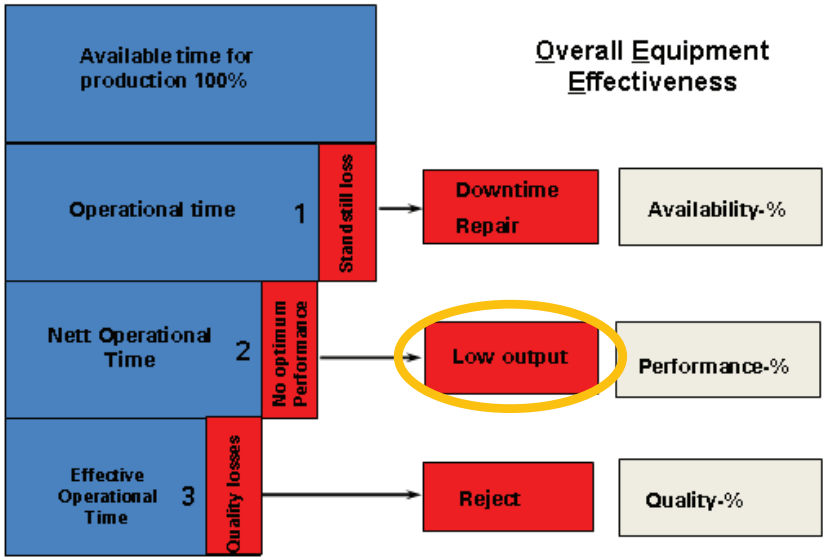
Automatic scanner calibration

- Enter pipe diameter and formulation
- Measure real Output
- Measure line speed
- Calibrate Scanner

Continuous line control loops



5: Increase Overall Equipment Effectiviness



OEE = Availibility-% x Performance-% x Quality-%

How do you define the optimum output
for the pipe you produce today?

6: The optimum Output

Let the Extrusion Line control configure the settings, and determine the optimum output, based upon:

- Product Spec (material, pipe dimensions, quality requirements)
- Line Layout (extruder, die head, cooling length, haul off, cutting, socketing etc)
- Factory conditions (ambient conditions, cooling water conditions, material supply etc)

Let the Extrusion Line Control preset the setpoint parameters

Let the Extrusion Line Control continuously compare and report the actual output with the optimum output

7: Collect other Process Parameters

Continuously collect and store process parameters:

- Actual output (Gravimetric) and Wall Thickness
- Motor Load
- Dosing Speed
- Screw Speed
- Die Pressure
- Heating Temperatures (set and act)
- Cooling and Calibration conditions
- Ambient Conditions

The quantity of sensors and the amount of registered data will increase significantly.

This fits into the Industry 4.0 philosophy

8: Generate Alarms and Recommendations

Based upon actual parameters and the combination of parameters, generate alarms and recommendations.

Observation
Mass temperature high (203°C)
Screw filling low (370 g/rev/hr)
Motor load low (68%)
Advice: increase screw filling to 450 g/rev/hr

9: Find correlations between proces conditions and pipe QC data

Big Data mathematics for finding unexpected root causes of problems will be part of the extrusion line control.

These conclusions will help to define recommendations, increasing processing window and increase performance.

10: Guided Start and Stop

Starting and Stopping the extrusion line involves a sequence of actions.

Let the Extrusion Line Control guide the operator in this process.

Optimal Actions in the Optimal Timing

Startup Sequence
Pre-heating is finished
Specific output set to 0,250 kg/rev/hr
Start extruder and ramp up to 250 kg/hr

Monitoring and improving the performance by comparing the actual timing with the script.

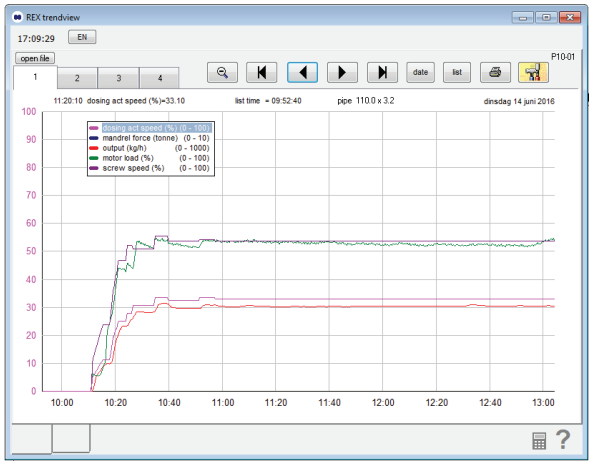
11: Collect and report all data centrally

Let the Extrusion Line Control report raw and condensed data to factory management.

Create the factory Dashboard

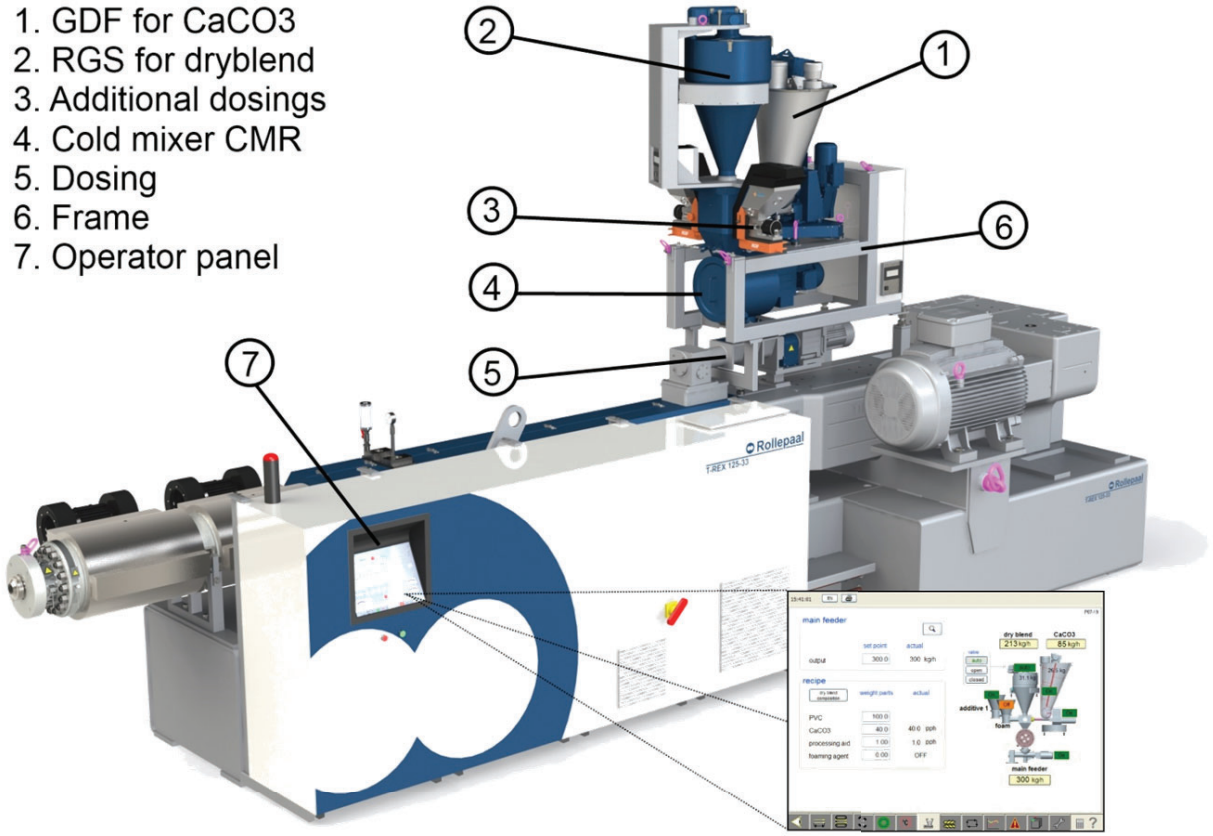
Zoom in on details if necesary

Generate long term trends



Also think about Direct Addition of CaCO3

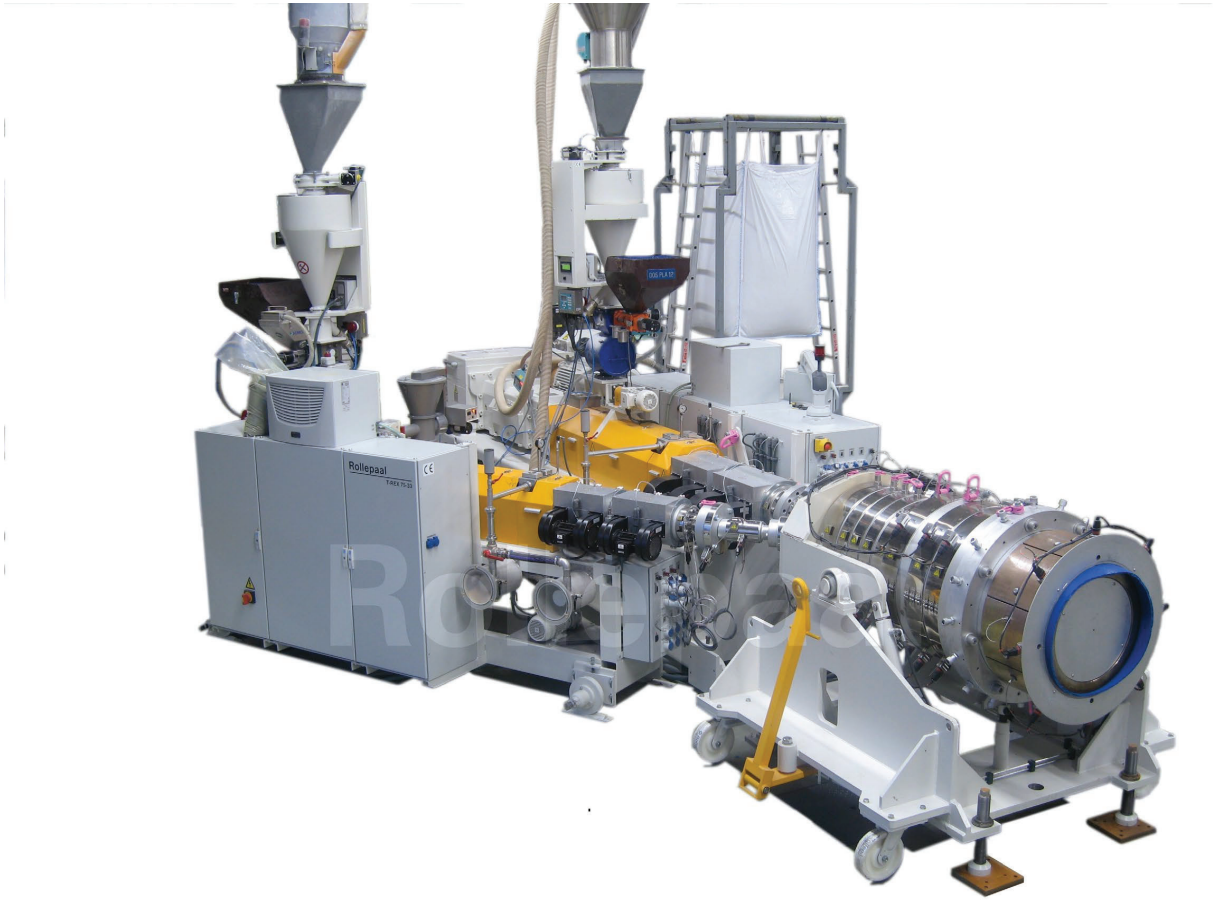
1. GDF for CaCO3
2. RGS for dryblend
3. Additional dosings
4. Cold mixer CMR
5. Dosing
6. Frame
7. Operator panel



15%

material saving

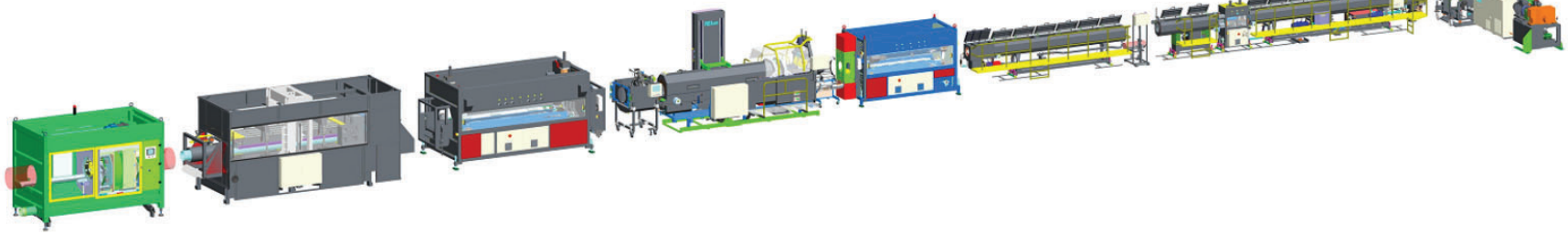
think about Multilayer Foamcore



30%

material saving

think about PVC-O



RBlue

the name of PVC-O

60%

material saving

But first….

But first….

Start with step 1

Measure your real overweight

It’s (almost) for free!

Reducing Material in Plastic Pipe

Thank you for your attention!

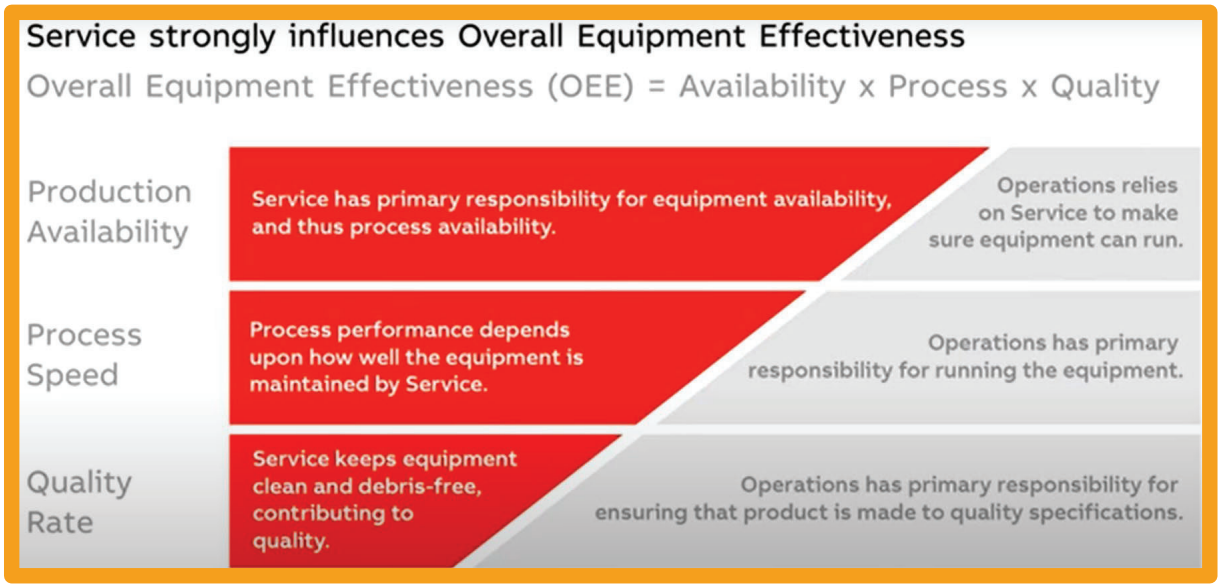
www.rollepaal.com

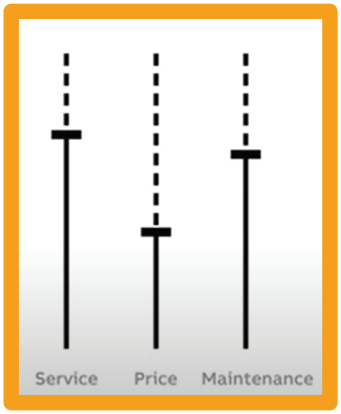
Questions and Answers

rollepaal

SAPPMA
southern african plastic pipe manufacturers association

How about a Quality Service Facet ?





Service Operations

Service strongly influences OEE Overall Equipment Effectiveness

SAPPMA
southern african plastic pipe manufacturers association

Important Facets Shapes Your Future

Allow Our Valuable Members To Assist

We have many facets to offer you

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Questions and Answers

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