Online Quality Control of Polymers and Extruded Films
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  Technology, Benefits, Online Lab, Close Loop Concept
- Web Inspection in Film Extrusion
  Technology, Benefits, Integration
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Online „Closed Loop Control“-Concept

Additives → Process → Production → Sampling

Raw material → Process

Feedback → Determination of the process parameters → Process computer

On-line Quality Assurance

Data (opt. measuring technique)
Principal of Online Quality Control

Production of Polymer Pellets

Pellet Transport System
Pellet Sampling and Transport

Film Extrusion
Blown Film / Cast Film

Measurements on Extruded Films

Gloss Measurement
Thickness Measurement

Gel Counter
Haze Measurement
Polymer Analysis by FTIR Spectroscopy

Pellet Preprocessing
Dedusting / Drying

Measurements on Pellets

Pellets Color Measurement
Pellets and Powder Inspection
Pellets Throughput Measurement
Pellets Size and Shape Distribution
Melt Index

Film Extrusion
Blown Film / Cast Film

Measurements on Extruded Films

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Benefits of Online Control

- **Process Control**
  (Optimisation, capacity, cleaning, waste)

- **Product**
  (better quality, customer satisfaction/relation, less claims, more competitive products)
Online Measurement of Pellets

- Pellet Analysis by NIR Spectroscopy (PANIRS)
- Pellet Color Measurement (PCM)
- Pellet Scan (PS25C)
- Pellet Throughput Measurement (PTM)
- Pellet Size and Shape Distribution (PSSD)

Measurements on Pellets

- Pellets Color Measurement (PCM)
  Measurement of LAB Color Values and Yellowness Index
- Pellets and Powder Inspection (PS 25C, PS 25, PS 2 PT 2)
  Detection and Evaluation of Impurities in Pellets and Powder
- Pellets Throughput Measurement (PTM)
  Weight Measurement of the inspected Pellets over the time
- Pellets Size and Shape Distribution (PSSD)
  Measurement of Size and Shape of the Pellets
  Detection of Twin, Triple and Multiple Pellets
Pellet Scan System

- Hopper
- CCD-Camera
- Lighting unit
- Pellet stream
Pellet Scan System
Pellet Size & Shape Distribution

- Hopper
- Pellet stream
- CCD-Camera
- Lighting unit
Pellet Size & Shape Distribution

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Mean /μm: 3671.90
StdDev /μm: 432.45
Weight/kg: ___
Pellet Size & Shape Distribution
Pellet Colour Measurement
Online Measurement on Extruded Films

Film Extrusion
- Blown Film
- Cast Film

Measurements on Extruded Films

- Gel Counter
  Detection and Evaluation of Gels, Fish Eyes, Black Specs

- Gloss Measurement
  Measurement of Gloss of Extruded Films

- Haze Measurement
  OHM
  Measurement of Haze and Transmission of Extruded Films

- Thickness Measurement
  TMD
  Measurement of Films Thickness

Polymer Analysis by MID-IR Spectroscopy
Online Quality Control
Online Integrated Measurement Solution
Online Integrated Measurement Solution
Online Gel Count
Online Gel Count

[Image of a computer interface showing a measurement window with various statistical data and images of gel samples.]
Defect Types

- Gels
- Black Specs
- Contaminations
Web Inspection in Film Extrusion

100 % Optical Control of the Web

- Photo of every defect
- Position of every defect
- Database Interface
- Reports
- Alarms
Benefits of Web Inspection

- **Process Control**
  (Optimisation, capacity, cleaning, waste)

- **Raw Material**
  (Optimisation material + recipe, control material)

- **Product**
  (better quality, customer satisfaction/relation, less claims, more competitive products)
Origin of Defects in Extrusion

- Extrusion Line
  (screw geometry / dead zones)
- Resin
  (contamination, recipe)
- Production Process
  (extruder temperatures, screen change)
Defect Types in Film Extrusion

- Gels
- Black Specs
- Contaminations
- Die Lines
- Insects
- Lamination Defects
- Oil Stains
- Fish Eyes
- etc.
Web Inspection System
Embedded Multiple Camera Solution
Embedded Solution Technology

- High Speed CCD Line Scan Cameras
  80 – 160 MHz, 512 – 8192 Pixel
- Embedded PC with High Speed Framegrabber
- Windows XP Server (network)
- Exact information on defects within the web
  (mosaics, position, alarms, protocols, storage)
Quality Reports / Alarming

- Single Defect
- Trend Defects (20 gels per m²)
- Slit Defects
- Repeating Defect
- Gel Shower / Cluster
- Roll Defects
Rolling Map / Die Defect
Time History (Gel Level)
Mosaic View
3-D Defect Analysis
Lane Distribution
Die Defect
Calander Defect
Alarms / Repeaters
Teach-In Function - Fly
Teach-In Function – Oil Stain
Teach-In Function - Gel
Teach-In Function – Black Spec
Inspection Systems
Inspection Systems
Closed Frame
Interrelationship and Correlation Example

- Online Compound Control (Gel Analysis)
- Oracle Database Integration
- Decision for Film Extrusion Quality (Grading)
- 100 % Web Inspection in Cast Line (Diaper Breathable Film)
Online Container for Plant Control (Example)
Gel Shower
Online Anticipation of Plant Shut Down

Start injection cleaning agent

Plant shut down
Online Transition Control

- Start extruder cleaning
- Stop injection cleaning agent
- Stop extruder rinsing
Online Control of Extruder Start Up

Extruder startup after plant restart, start extruder cleaning

Stop injection cleaning agent

Stop extruder rinsing
Summary

- Close Loop Online Control (Process + Grading) is today‘s Standard in Polymer Plants
- 100 % Web Inspection in Film Extrusion
- Different Defect Types, but close Interrelation
- Working Together avoids Problems and improves Film Quality
Thank You
very much
for Your Attention!