Optical Control Systems ®

The solution for the polymer & petrochemical industries

Rheological & Physical | Property Analysers

R & D, QC, Lab & on-line application

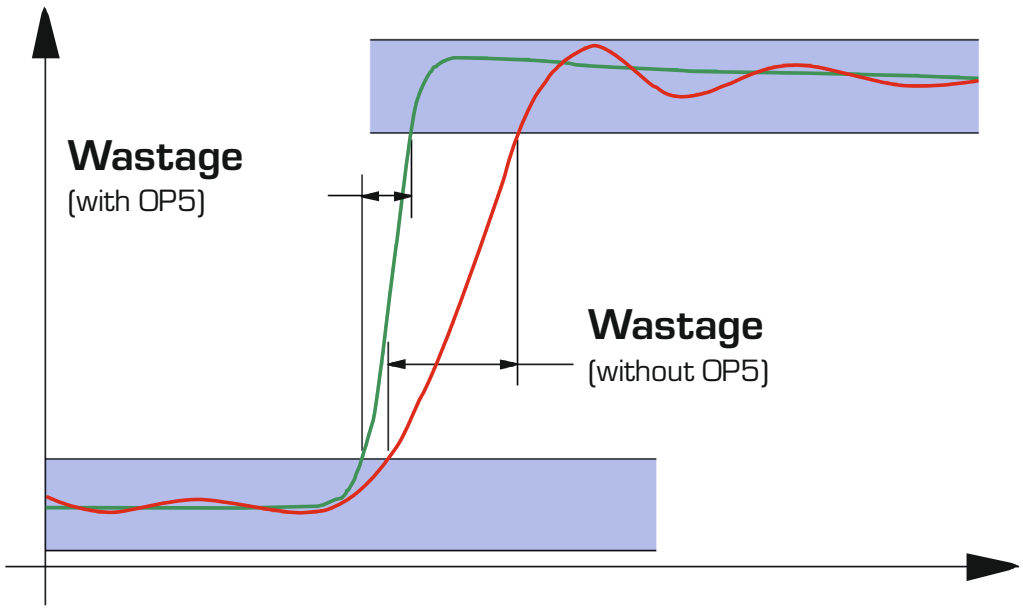
On-line Rheometer OP5

Plant optimisation & improved product quality

The function of the OP5 is to make certified measurements of the melt index and/or polydispersity of small solid polymer samples. The primary duty of these measurements is overall control of many types of polymerisation processes. This ensures that the product can be made to specific formulations. The secondary duty is quality control in final product selling specification and in batch control. The OP5 is logically situated in the plant analysis laboratory, which ensures best reliability and maintainability for these calibrated, precision measurements. Representative samples are therefore transported from various locations of the polymer manufacturing plant at the call of each analyser. Process control and QC are full-time activities, which require, as a minimum, one sampling point for each analyser.

Representative samples are extracted from each reactor stage and from the finished product. In simple plant configurations, such as LDPE, PS, PET and nylon this usually means one OP5 but in complex plants such as PP, HDPE and LLDPE two or more OP5 analysers would be required. The complex plants have powder samplers, which have degassing and catalyst deactivation stages close the analyser. At the plant end, these samplers can extract at the main discharge valve(s) of the reactor or at the primary degassing vessel, etc. according to the plant configuration. In the case of the pellet samples, these would normally be supplied from central (OCS) source, and in such cases the supply to the rheometers carries a priority to minimise the sampling delay time.

Melt flow measurements are performed after the solid sample is melted and conditioned to the appropriate test temperature. In the OP5 the melting process minimises any changes to the structure of the polymer but making a very rapid transition from solid to liquid, which substantially obviates shear damage, cross-linking, thermal



degradation and other degradation processes. This sample preparation removes the last traces of any trapped air or gas and overall makes an important contribution to rendering the sample at the point of measurement fully representative of the process. In this unique way the OP5 makes control through rheology as reality.

The melt flow is regulated by a sealed gear pump, which transports a metered quantity through a shaped die which has the normal MI die L/D. The shaping of the die is to minimise the delay in the slow moving polymer near the walls, without deviating the actual rheology relationships too far from the standard MI die.

Measurements of pressure and flow rate are used to derive the standard melt index. Many features of the apparatus for measurements are covered in the patents.
The patent, melt flow determination in polymer process, has the following grants, EU 989 45440, GB 233 4958 and US 09/622558. These patents also have integrated process control application. Systematic correlations are applied to compensate for the relationship between the OP5 die and the lab test die (both ASTM D1238 and ISO 1133 tests use the same die form). The corrections derived from these correlations are specific to the actual polymer process and the local test methodology used to make the test. This is because each plant produces subtly different polymer structures and the manual test method result varies with operator and procedures. Once established the corrections do require regular verification, which is supplied through the OP5 operating software. The IPR of the operations are described in the EU CTM, Registration Certificate No 002729309. The methodology of calibration and measurement gives the OP5 class leading accuracy, which can be used to certify the finished product and thus completely replace routine testing using the lab melt indexers.

The OP5 measurement of melt index is performed in a batch process, termed a cycle. The MI result is based on a tiny part of the sample, which gives the OP5 a pin point accuracy. The result shows every small variation in the polymer product and which can be used to steer polymer reactions in a way not possible by long term averaging or less than adequate sample preparation.
The MI result can of course be used for quality control but the finely resolved and accurate measurements will bring a better precision and thus maximise the added value of the production.

Typically the OP5 samples every 5 minutes to fit in with the cleaning-measurement-sequence. The delay of measurement is slightly greater than cycle time of the sequence. Although the cycle has been optimised for accuracy but by using the necessary cleaning part of the cycle, the delay is made nearly independent of sample MI value. The real time delay (7–10 min) between the reaction and the measurement, which includes any sampling and sample preparation delay, is comfortably below process requirements whether it is used for reaction control and QC. In fact provided the delay is adequate, process control and QC places a very strong requirements on full-time calibration and best accuracy.

The unique features of the OP5 equipment open up the huge opportunity of process control through rheology.

Control & optimisation of polymerisation by using melt index

I. Key statement

Positive control of the polymerisation process from MFI provides the definitive means of making to recipe. An integrated approach results in improved plant efficiency and product quality. With a full understanding of the processes involved, lasting benefits to the whole of the polymer industry, from manufacturer to down stream processor will surely follow.

II. Introduction

The continuing need for optimisation of polymer plants, as with any process, is self evident. A fresh approach has been needed, since the subject has received close attention from major plant suppliers and polymer manufacturers.

Key polymer properties, such as tensile strength, impact resistance and melt viscosity, are related to Average Molecular Weight (AMW).

Polymer production relies on close control of melt viscosity, which in turn determines the main properties of the material. The viscosity measurement is reported as melt flow index (MFI).

MFI is used world wide as the classification of product properties. This measurement is therefore equally relevant to the finished product and the conversion process, such as moulding or extrusion.

Ziegler-Natta catalytic reactions produce ultimately in fine powder form by continuous polymerisation, initially in a gas phase, or in a slurry phase, or both.

In these systems, primary control of the molecular weight is achieved by inhibition of chain growth using a terminator agent known as a Chain Transfer Agent (CTA). The relationship between CTA and

MFI in steady state takes the general form:

Log (MFI) = A + B x log (CTA/monomer)

Our control scheme for this type of polymerisation requires powder and gas sampling from, or close to, the reactor(s), in order to measure MFI and CTA at the reactor. The sampling, preparation and measurement has to be done without long delay times or changes in properties.
Together these two measurements form a cascaded control set up that has allowed fine adjustment of the polymer properties at source. Many aspects of this control and measurement scheme have been patented following successful closed loop operation of a leading gas phase PP process.

This approach can be equally applied to many other reactions including some LDPE processes. In all cases the opportunity arises for a more powerful optimisation of the process when this feedback technique is used in conjunction with any APC. The programme is also supportive to many existing plant developments.

Any future implementation of such a control scheme requires close cooperation between the polymer company management and the technology supplier. OCS is willing and capable of undertaking their side of any contractual intent.

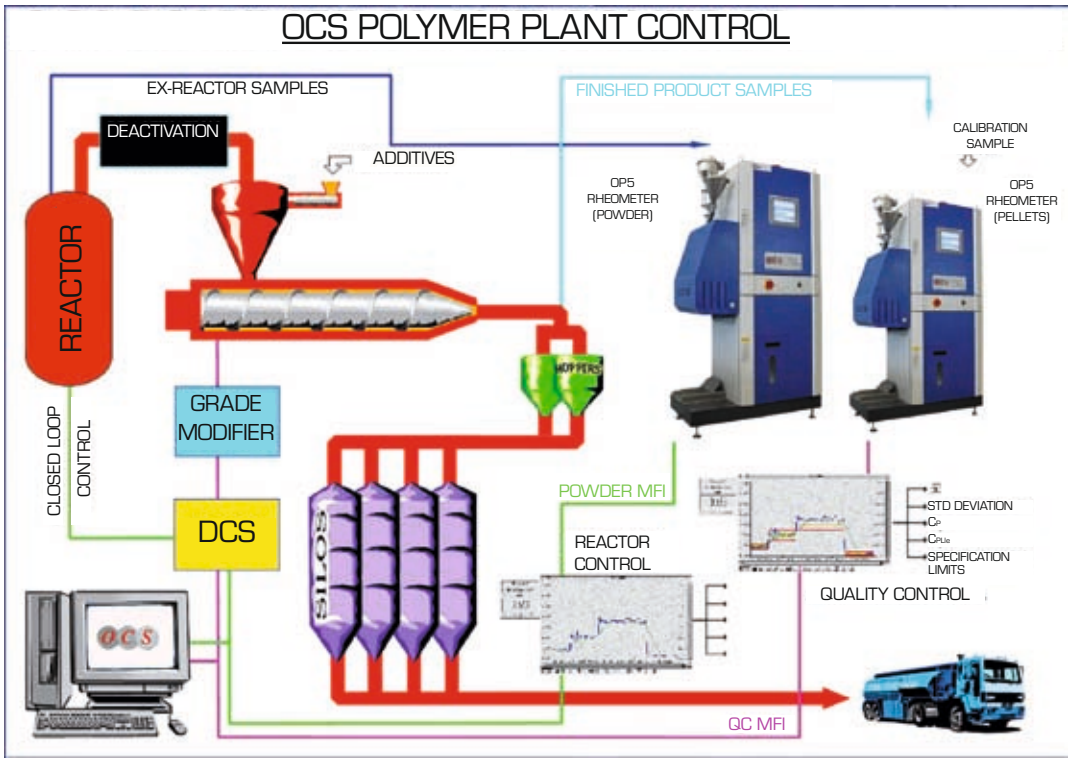
III. Difficulties of process control

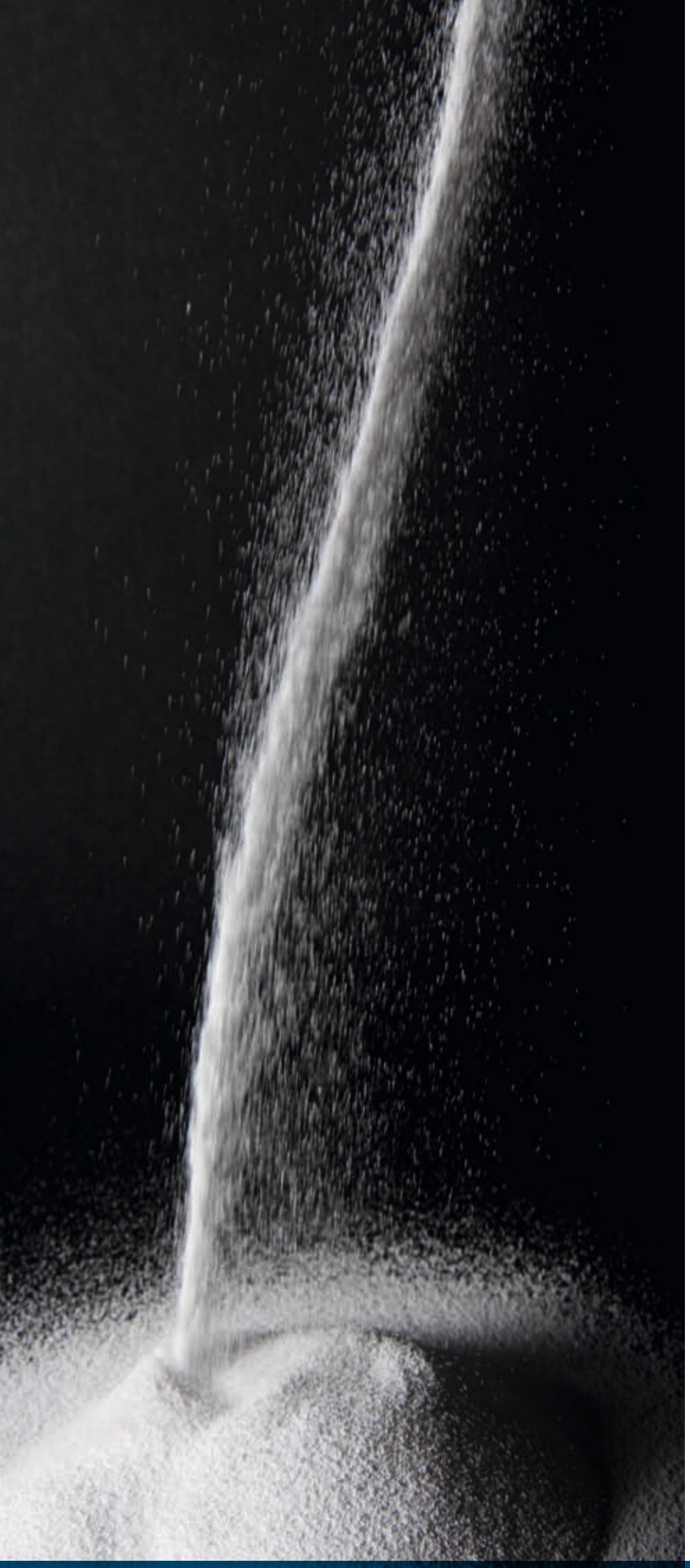
Conservatism

Rheology is not seen as an important part of the control solution in the polymer industry. MFI is used mainly as the QA tool for the final product selection.

Process

Many conventional processes have advanced by adopting modelling approaches (SPC) and by paying meticulous attention to many process measurements, and their subsidiary control loops. The example of control of LDPE, demonstrates that APC works with measurable success on this 'simple' type of process. It has only become possible for the clear reason that the delay, frequency and accuracy of standard non-automated MFI measurements can just about cope with the driveoff rates. Short term MFI is calculated from other plant variables.
In many Ziegler-Natta processes it can be very difficult to maintain steady conditions in the reactor even with modern gas chromatography equipment used for the control of CTA concentration.





Unsteady reactor conditions result in the manufacture of a wide variety of product structures, some of which will require down grading. Less frequent grade changes can reduce this but at a cost of higher stock levels. Up to 15% of product can be downgraded. Even good product so produced can have a large scatter of MFI. Downstream this can result in a 4% chance of receiving two successive batches at opposite ends of the allowable range. No help is available from calculations or MFI measurement too late in the process. In-reactor or ex-reactor MFI is mandatory.

System errors and delays

Often these two types of error together will totally hide the essential control relationships.

Errors

It is accepted that the MFI manual method can have standard deviations that are as high as 10% at extremes of range. Even the most modern lab equipment is barely acceptable as a control tool. There is little help from the automatic MFI equipment because the relationship between their values and MFI are neither simple nor consistent.

Polymer, powder especially, can easily be changed prior to measurement. Small extruder screw heating causes shear damage, mixing and thermal degradation – thus introducing large representation errors of the source polymer, making control impossible.

High mileage catalysts are very susceptible to minute traces of gas impurities. Gas impurities can lead to unknown errors in CTA-MFI relationship. These systems are vulnerable to changing the cracker (gas supply source) and reinforce the need for reduced errors to cope with a better recovery of control.

Much of the variability can be due to unpredictable changes to the polymer, which can occur immediately after the sampling. Ex-reactor sample requires early preconditioning to remove monomer and the activity of the catalyst. Even when the catalyst is killed the residues will cause chain breakage, especially if oxygen, shear and heat are applied.

Delays

Sampling and measurement both incur delay: variable delay will result in degradation of control performance.

A measurement delay behind the reactor of greater than 20 minutes will typically ruin any feedback control, if the reaction that has a response time of 90 minutes.

Placements of MFI facilities

The new control duties qualify the complete system for the plant-critical list, in a similar fashion as the CTA measurement and control facility.

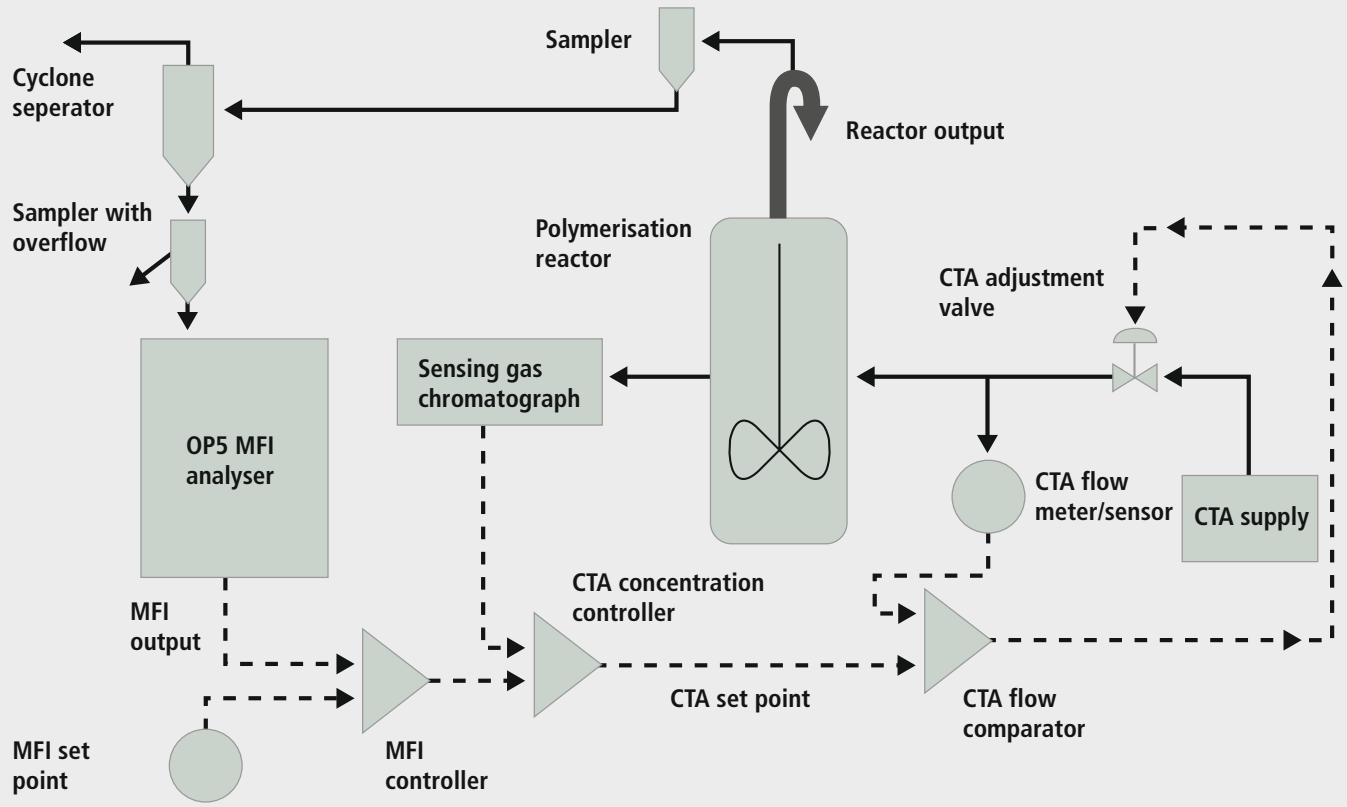
Accordingly the powder MFI analysers must be placed in a suitable area where they can be properly serviced and calibrated. The plant samplers must meet ATEX requirements, as they will be placed in a hazardous area.

Reaction control from pellets

The control of reaction from the finished product needs to be completely rethought. The main extruder placement fails to provide a site for accurate automatic MFI determination. This is mainly due to calibration drift at grade changes, which renders the equipment unusable during critical times. In most cases, particularly in visbreaking PP applications, the extruder sample does not represent the finished product. Maintainability at the main extruder site is below the standard required.

Successful as it is, the APC approach does not provide any regular quality assurance of finished product during normal running. During process excursions or grade changes QA completely breaks down, causing more than necessary product to be segregated and handled separately. Out of necessity current APC still prefers to calculate MFI or AMW.

Schematic for MFI/CTA controlled polymerisation reaction



IV. The four part OCS solution

a) Incorporation of rheology into process control

To stabilise the process

b) Sampling from the reactor and finished products

To represent process at key points

To measure in suitable environment

c) Better rheology measurement, suitable for process & QC alike

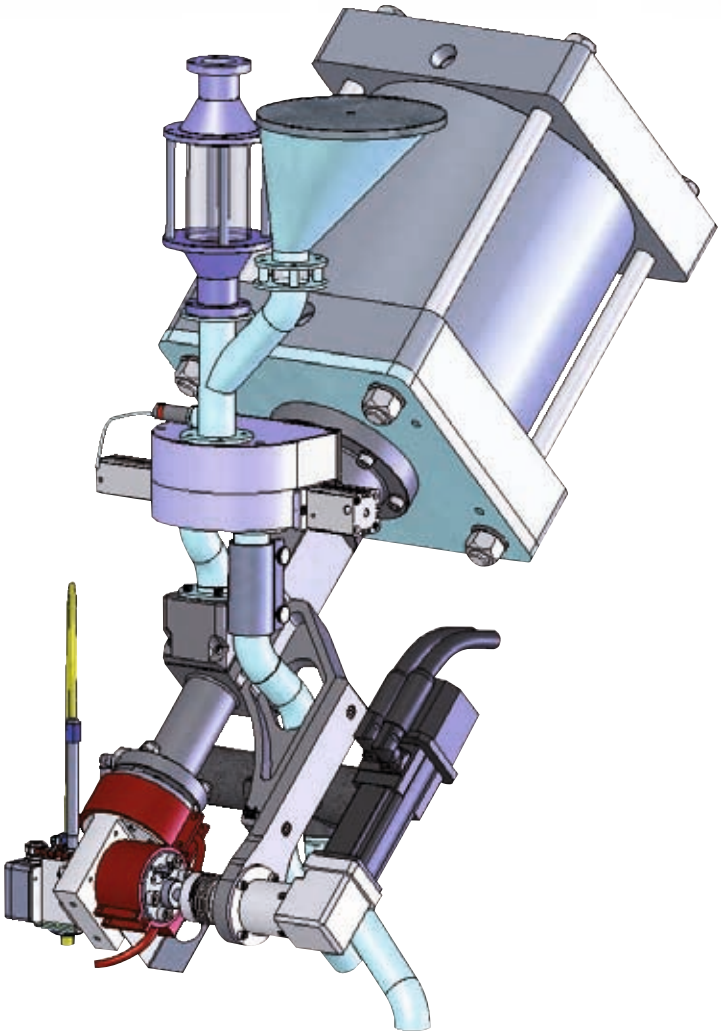
To measure the process faithfully

To achieve full-time calibration

To achieve rapid response

d) Integration of measurements into APC

To gain advantage of ongoing optimisation



a) Rheology in process control

Where the delay from the reactor to finished product is small, the measurement of pellet MFI has been shown to be entirely suitable as the means to control the reaction. LDPE falls into this category but so does any extruder-based reaction, such as the visbreaking of PP by peroxide.

Complex plants, typified by the PP process, have one or more monomer reaction stages. Long time delays between these reactors and the finished product require us to use the ex-reactor product for the means of feedback control. This type of control has been achieved using the MFI-CTA relationship, which is briefly described below.

The CTA-MFI control diagram shows the schematic for the monomer reaction equation.

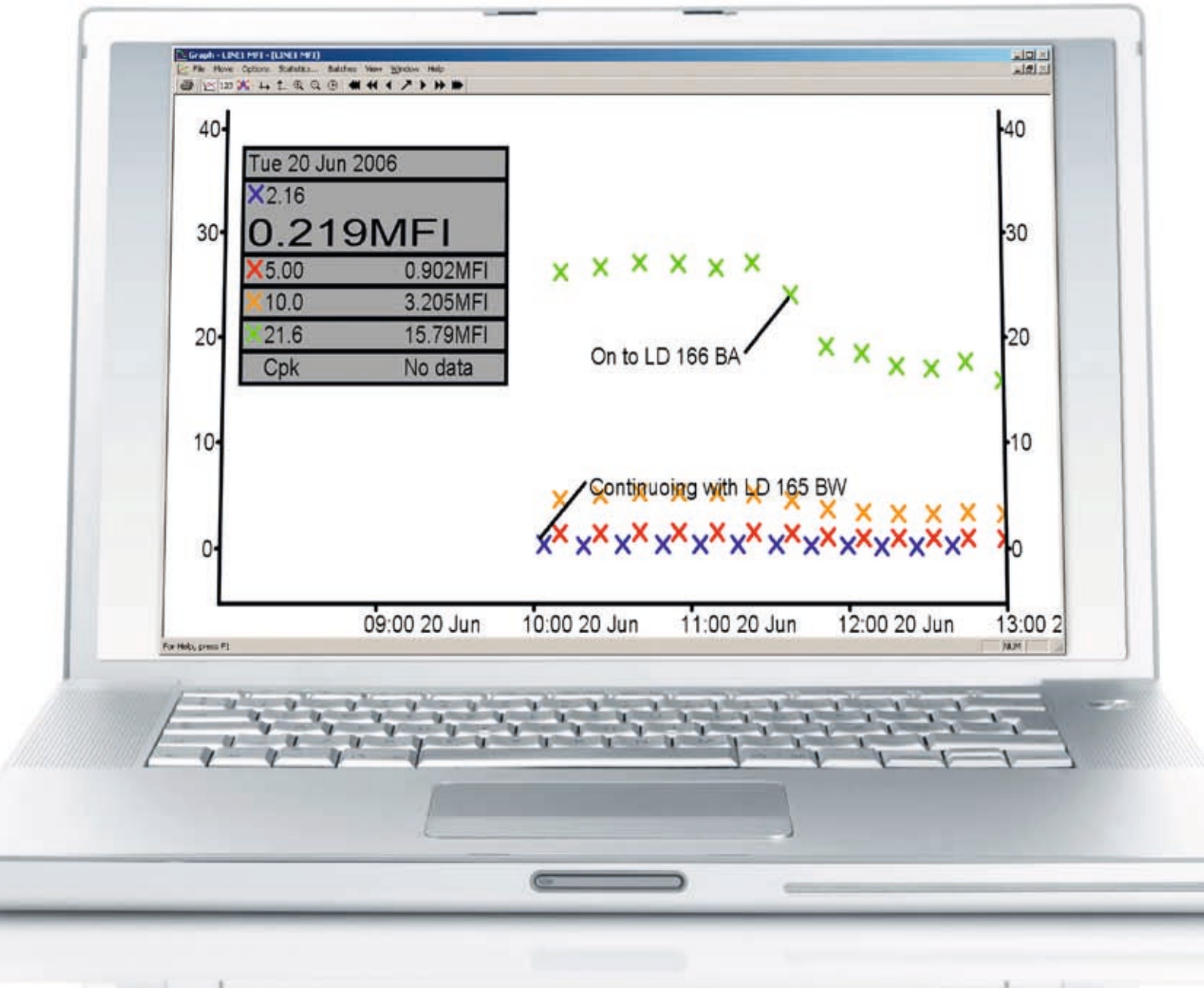
Log (MFI) = A + B x log ({CTA}/{monomer})
Where
{CTA} = molar concentration of CTA
{monomer} = molar concentration of monomer

A similar equation applies where only the CTA flow can be measured but with new A/B values.

The reaction controller works as a pair of cascaded loops. The inner loop controls the CTA flow to obtain a given concentration/flow. The outer loop controls the set point for the flow controller from the OP5 output and the MFI set point of the recipe.
The inhibitor leaves the catalyst able to start polymerisation of a new chain.
Natural termination of very long chains, which is known as Thermal Termination, occurs at low CTA concentrations.

Similar equations apply in the other major reactions including all types of PE and PS.
Visbreaking in PP works in a similar way and uses peroxide as the chain breaker.

Extensive regression analysis, taking care to cover steady state and transition conditions, is a pre-



cursor for feedback control and of course APC. We advance with the new MFI factor, by making the control much more definitive and therefore more stable. But more importantly the opportunity to gather very accurate information on an on-going basis will allow the process to be optimised. At this better level of stability the APC model can now 'afford' to become adaptive. Process people will recognise that this will provide a strong platform for product development.

We find that MFI is a key process driver and when correctly integrated into the control system it provides a safe and secure way of operation.

b) Representative sampling at key points

MFI equipment that can equally handle powder and pellets without change, opens up the practicality of the centralised measurement facility. Remote sampling and sample transport are key. The advantages that accrue from this approach (maintainability, system back up, reliability, low delay, accuracy) are fully in keeping with the extra duties of control.

Finished product sampling

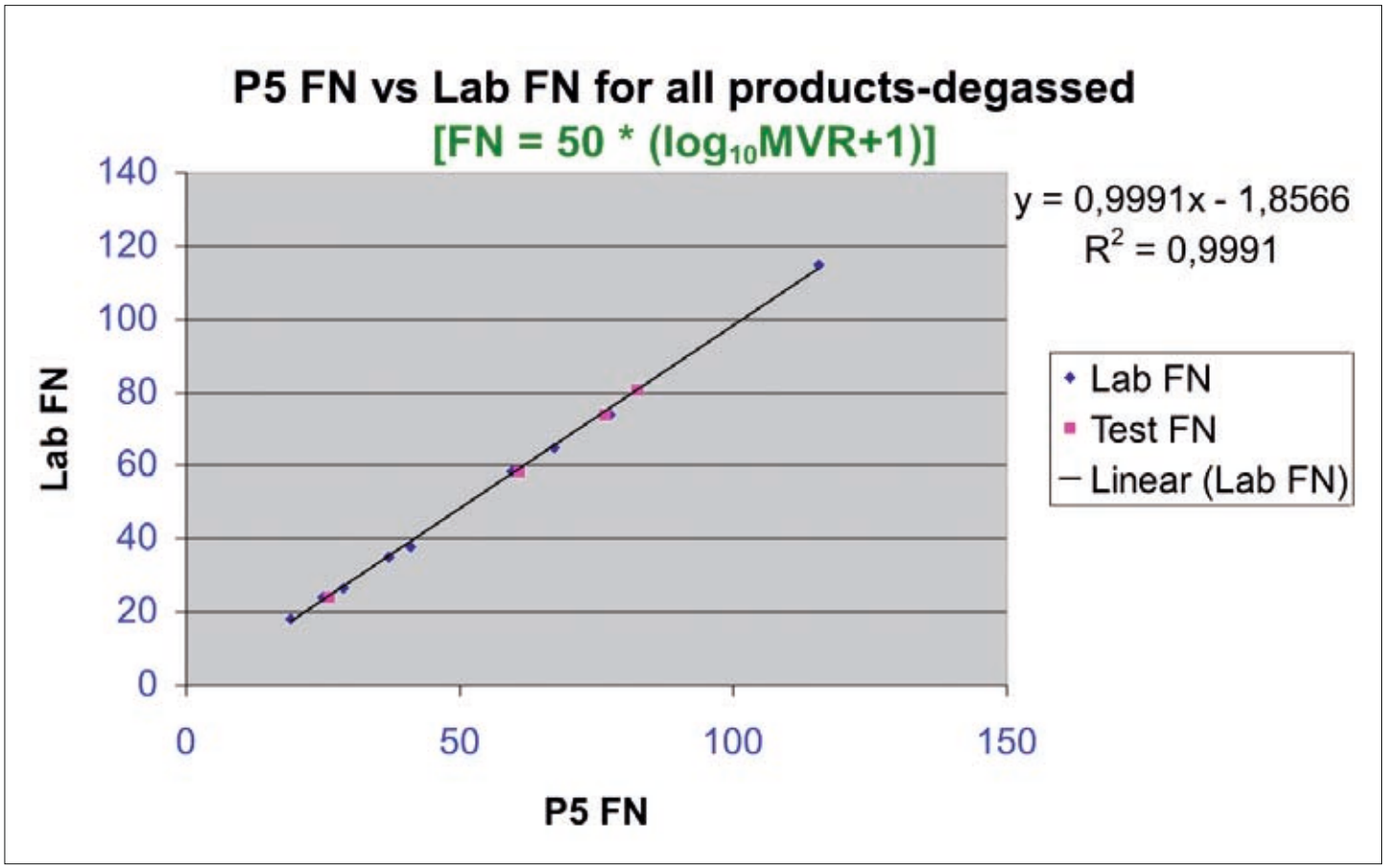
Has shown itself to be the best representative of the low delay categories of reaction. (LDPE, PS and PP visbreaking etc.) OCS routinely supplies industry quality samplers and sample distribution

systems. These extract sample directly after the extruder and transport the product to the analyser house or laboratory with a minimal delay.
There is every reason to use the OP5 as a combined QC and reaction control tool in these instances.

Ex-reactor sampling

The control of the reactor has been shown to be possible by sampling directly at the main discharge valves, which are situated within a metre of the reactor outlets. These standard, heavy duty valves have been modified to become four port valves. A small quantity of polymer and gas becomes trapped each time the valve is closed.
At the request from the MFI powder analyser, through the DCS, the slave PLC sequences a timed blow of high pressure nitrogen to eject the sample through the auxiliary ports. The nitrogen charge acts as a diluent to the monomer. The PLC ensures that by the time the sample has been transported to the cyclone above the OP5, the monomer concentration will be below 10% of LEL. Safety checking to full ATEX certification is accomplished via pressure level interlocks to make a robust fail-safe system. This sampler contributes only 60s to the measurement delay.
Other systems have been used for powder measurement. Sample is extracted after the primary degassing stages. Again transport is by nitrogen. These systems provide essential information of reactor product condition but at a considerably longer delay (10 - 30 min, according to plant design). This information can establish the control parameters but is more suitable for model (APC) purposes than direct feedback control. However our ultimate intention is to provide an optimisation facility through APC.

Any sample from the reactor will contain live catalyst. The entire sampler and front end of the OP5 analyser is therefore designed as a closed system to prevent or limit further reaction. The transport gasses are vented to flare or back to the process. Catalyst residues are handled inside the analyser.
Transport of sample (powder or pellets) over long distances is not an obstacle. Sample can be safely moved over large distances (> 330m) without loss of representation or either reactor or finished product information. Delay is not significant.



c) Rheology measurement

The polymerisation control system has been shown to work most efficiently when it is supplied with a measurement of MFI that is representative of the reaction product.

The OCS equipment achieves its part in this exacting performance, whether on powder or pellets. This OP5 MFI analyser works with discrete samples. It uses a few specialised processes, all of which reduce the real delay from the reactor to the measurement. The received sample is sized to the minimum required for each test. For the powder sample the excess, if any, is valved to waste. For pellet sample a shuttle valve passes the required amount into the ram system.

The ram feeds the gear pump via a static melter. This avoids any shear damage to the structure but melts material in approx. 30 seconds. From its inception, this type of equipment has not needed any additives, as the melting and other processes do not cause any detectable changes to the polymer structure.

Material from the gear pump finally passes through the die. Dies have diameters ranging from 0.6 to 4.5 mm, principally to optimise the gear pump delivery span.

The OP5 cycle time, typically 4,5 min, is virtually independent of the MFI value.

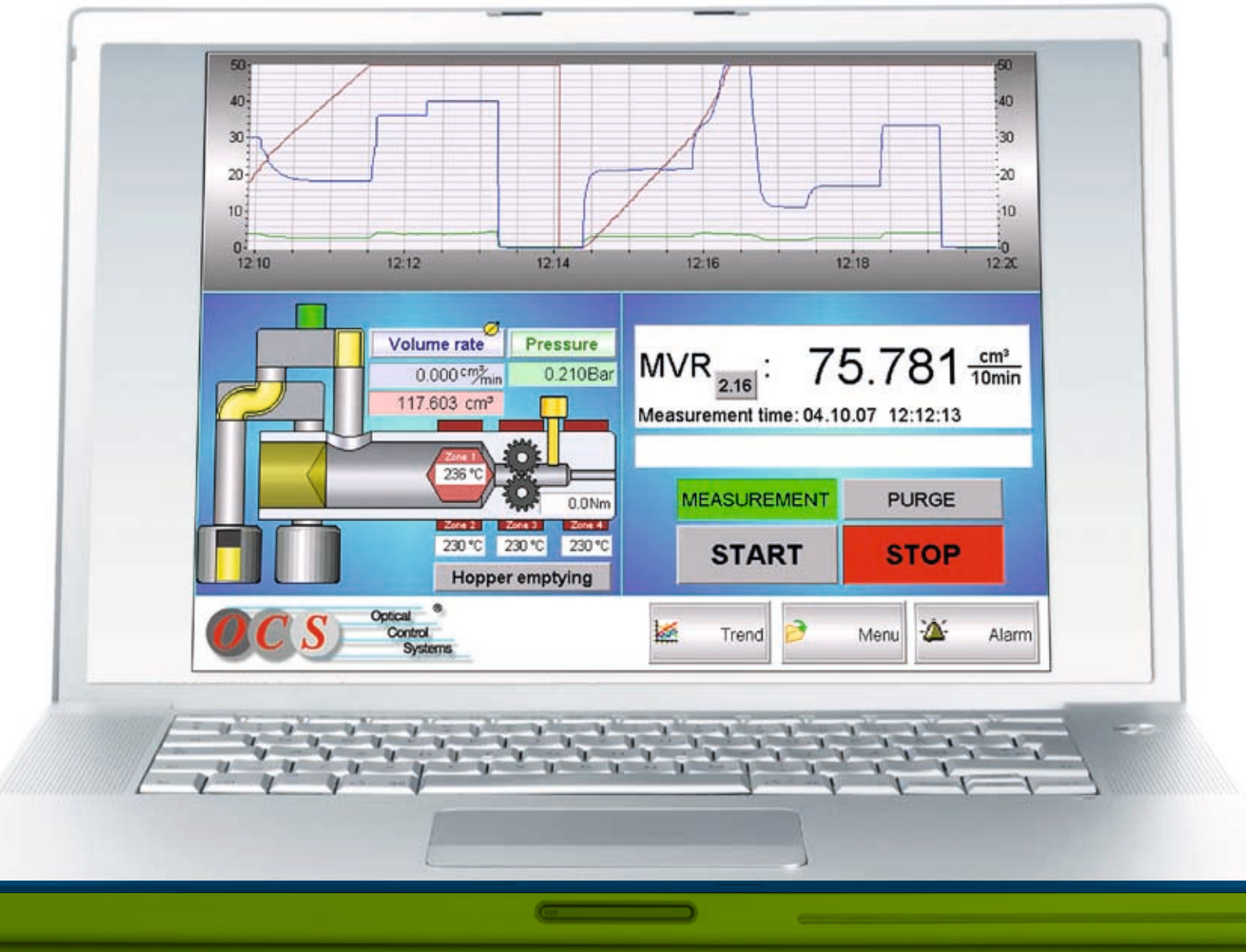
The cycle starts with a purge, to clean out the old material. This is followed by a measurement that has two flow rates, which straddle the appropriate lab MFI pressure condition. The two flow rates and pressures allow close emulation of the standard MFI test. This complete technique also has the merits of very tight calibration to the standard lab without the drawback of variable delay according to grade value. The graph above shows a typical calibration with the Lab standard. One die normally suffices for the entire product range.

The present design of the OP5 is a culmination of many years of application in the control and QC fields, which has fully realised the twofold vision of CTA-MFI polymerisation control and the certification of finished product.

d) The integrated control scheme

It is intended that the process be controlled at the reactor(s), using means as described. Although the approach has been proven on PP gas phase and LDPE process it is still a relatively unknown area to most users.

To facilitate a more complete understanding of the processes involved and it's implications, one examples is laid out in some detail below. Similar templates can be prepared for other processes.



The programme for PP – all variants including co-polymer:

Objectives

1. To measure ex-reactor powder in real time
2. To control visbreaking from MFI
3. To improve transition times
4. To minimise in-spec variations
5. To narrow blend max/min values closer to target
6. To provide platform for product enhancements and development

Requirements

1. Finished product testing equipment : 1 per reactor OP5 equipped for powder use, 1 per reactor PTS from powder source, 1 x OP5, 1 x PTS from pelletiser, 1 x central distribution centre priority to OP5, plus PS200C/FSA100/APLAIRS® equipment according to choice.
   The powder sampling and analyser requirement is onerous. But the information supplies important reaction data that is crucial to fine control and model making under a wide range of conditions, including varying impurity levels should these occur in the gas supply chain.

2. Plant assumed to be already equipped with adequate level of instrumentation and DCS with access for OPC preferred connection to OCS equipment.

3. LAN processing facilities to be considered for additional data handling.

4. APC package – to be capable of incorporation of additional inputs from MFI – to be capable of model update by continuing regression analysis.

5. Plant assumed to be fitted with sufficient temporary storage vessels etc. for cut and re-feed of transition and process excursion product.

6. Plant assumed to be adequately covered by 24/7 maintenance and support. Global support for OP5 and other, available via OCS.

Programme: Ongoing optimisation programme

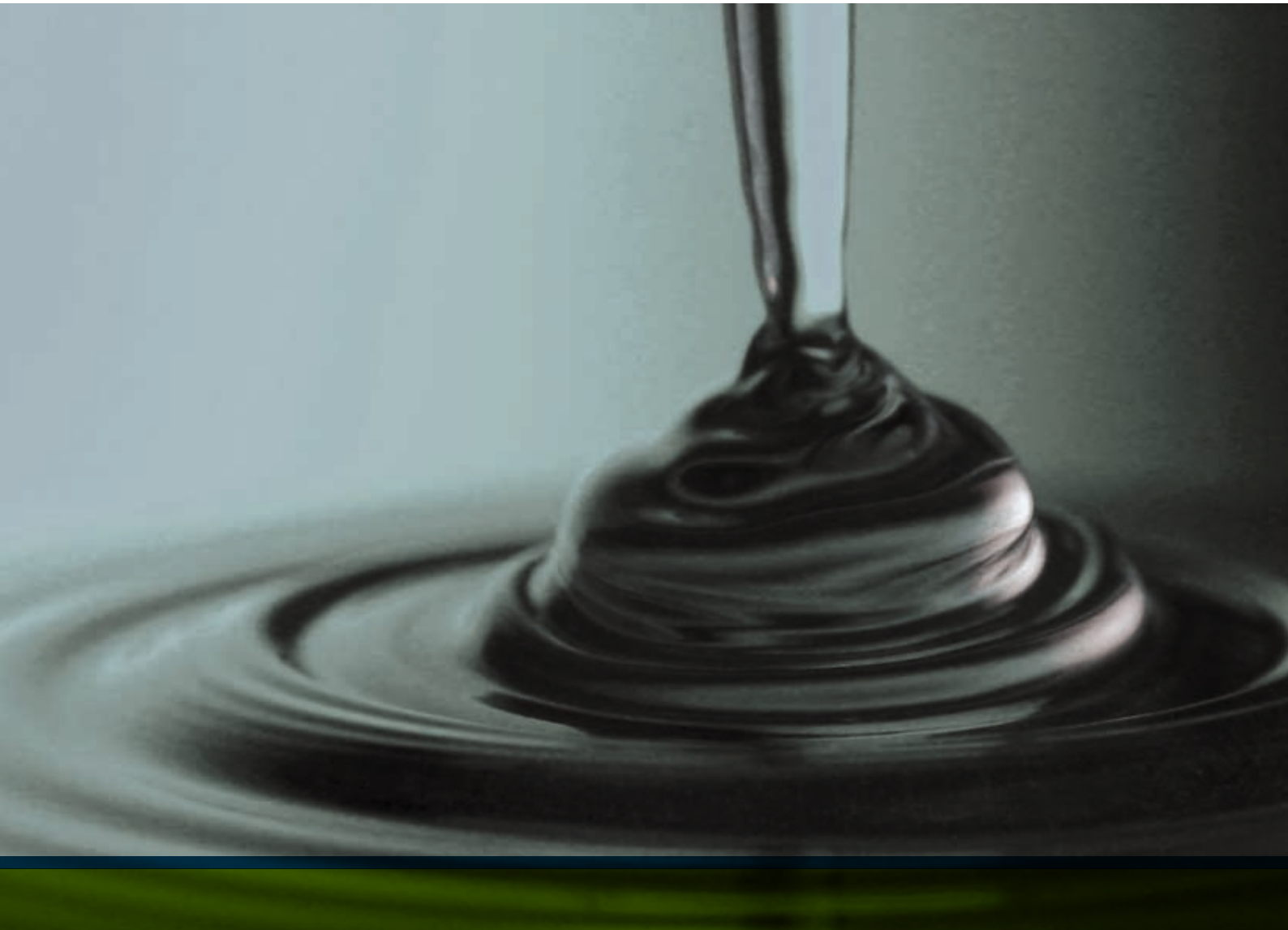
Task 1: Management and technical support
It is part of the contract that OCS is fully represented and responsible on an ongoing basis in these two functions.
Task 2 : Visbreaking control
Using pellet OP5 only. It is not necessary to have information of the powder MVR to make a premium control.
Task 3 : Full-time calibration
Using 1/day lab x-check and routine system maintenance of OP5.
Task 4: Replacement of MFI/AMW calculations in APC with real time OP5 measurement.
Task progress can be made only if rheometer has highest data quality and sufficient frequency i.e. OP5.
Task 5: Routine maintenance of APC modelling analysis incorporating OP5 output.
With particular note to irregular impurity/gas conditions and grade changes. Need for pinpoint timing and accuracy to characterise grade change materials, possible need for sample capacity storage to examine grade changes.
Plant/cracker may require modifications to clean-up gas impurities.

V. Deliverables

Visbreaking controller
Reaction control with improved stability and resistance to gas conditions
Improved plant utilisation
Improved plant performance
Reduced storage requirement
Improved product quality
Improved customer satisfaction
Better defined product specification leading to product development from large scale production
Plant optimisation, subject to agreed programme

Performance Characteristics

- Controls
  Menu-driven Windows interface and easy customisation
- Optimum location
  Use of laboratory environment to ensure high run time and accessibility for calibration and any maintenance
- Low delay time
  Fast sampling, sample preparation and measurement results in delay time more than adequate for control
- Accuracy
  Calibration is established by Transfer Standard™
- Optional full-time statistical process control packages
- Full-time calibration
  A statistical calibration system that conforms OP5 to the ISO 1133 or ASTM D1238 standards full-time
- Tables
  Tabular display according to individual cycle measurements of temperatures, pressure, flow rate, consumed weight of material, test results
- Set points
  Tabular display of all set points
- Real time display
  Continuous trend display of MI with tramlines
  Additional trend displays, temperatures, pressures, mass flow, total mass flow
- Recipe control of cycle and conditions
  Operator control via menu of parameters, sequences and user product names
- Alarms
  External alarm interface
- Open database
  All records can be converted into any standard file format
- Access
  Password protected to 2 levels



Scope of Application

Powder or pellets from polymer processes
Powder ex-reaction
Pellets post extrusion
Samples transported to laboratory via OCS systems

Technical Data

- Melt flow range
  0.05 - 1000
- Shear rate range
  0.1 - 2.5 x 105 sec-1
- Test temperature
  Up to 320 °C (400 - 450 °C on request)
- Repeatability
  Base 3 - Sigma level of +/- 1%
- Pellet/Powder consumption
  Approx. 0.6 kg/h
- Sampler feed arrangements
  Called on demand from OCS sampler
- Device interface
  Ethernet 10/100 M Base T
- Remote control
  WEB interface
- Size dimension
  (l, w, h) 120 x 60 x 205 cm
  Weight approx. 350 kg
- Power supply
  400 V, 3 phase + N + PE (5 wires)
- Compressed air supply
  Inlet pressure: 6 - 10 bar
  Volume flow rate: 300 Nl/min
- Temperature
  10 - 40 °C

Optional

- Computer
  Industrial Intel®Core™ 2 Duo
  Up-to-date-technology
- Software
  Operating system Windows XP Professional
  (latest technology)
- Physical interfaces
  [DC per external server]
  Ethernet 10/100/1000 M Base T, USB,
  RS 485, RS 232, digital & analogue I/O
- Communication protocol
  [DC per external server]
  MODBUS RTU, MODBUS TCP/IP, OPC, SQL,
  file transfer, PROFIBUS
  Implementation to other Fieldbus-Systems
  possible

Technical alterations are subject to change without prior notice

Full Notch Creep Test
FNCT

The FNCT is a widely used method to classify polyethylene materials in regards to their slow crack growth behaviour under accelerated conditions: **ESCR** (Environmental Stress Cracking Resistance). In this test, a typically square sample is submerged into a surface active agent. This agent accelerates crack growth. Depending on the chosen test conditions, the agent is held at a certain temperature (up to 95°C) throughout the test. A steady tensile load is applied to the sample, which has a defined circumferential notch to initiate the crack, followed by crazing, crack growth and finally brittle failure. The time to failure is measured and used for the classification of the material. The different test conditions and parameters are summarized amongst others in ISO standard 16770.

Although the test was originally developed to evaluate PE materials for pipes, it is also used to investigate the long term behaviour and durability of samples made with other manufacturing methods (e.g. blown moulded containers, welded and extruded parts) and other polymers.

Performance Characteristics

- Setup sample stations
  15 stations with independent force application and independent data recording
  Load application by easily adjustable leverweight system
- Sample basin
  2 exhaust-connections with condensate recirculation
  Drainage connection required for overflow and flushing
  Temperature distribution by an external full under-floor heater
  Constant circulation by stainless steel centrifugal pump
  PH-value monitoring with adjustable warning events and automatic emergency procedures
- Test time range
  No time limit on test periods
  Time resolution: 1s (real time clock)
- User interface
  TFT Touch Panel with visualisation of all machinery parameters and test characteristics
- Interfaces for external equipment
  Ethernet interface for external OPC server
  WEB browser for remote control
- Alarm functions
  Optical- and acoustic alarms
  Event messages via Ethernet interface
- Open database
  Recorded data can be converted into all standard file formats (Access, Excel, etc.)
- Chemical resistance
  All materials directly exposed to fluid are stainless steel metal

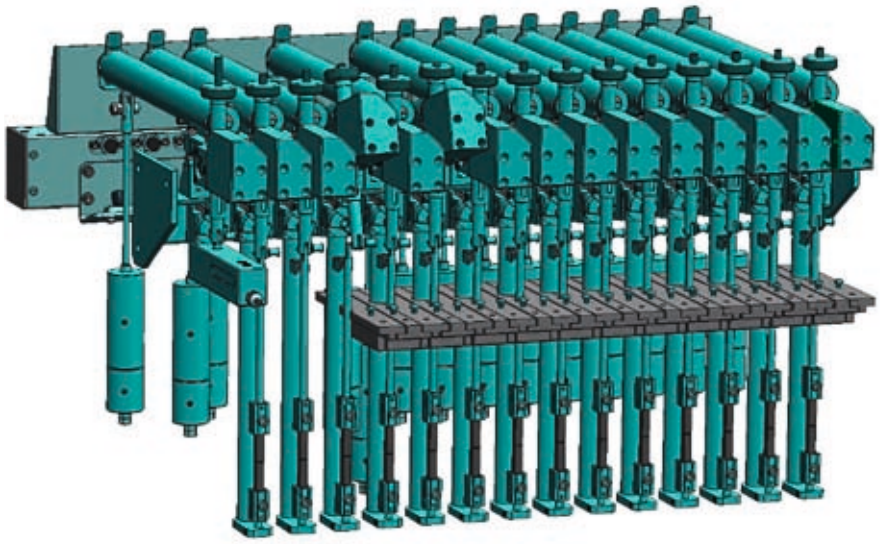
calorifier optionally

Technical Data

- Load range
  4 - 6 GPa on samples 10 x 10 x 100 mm
  (6 to 9 GPa on samples 6 x 6 x 90 mm optional)
- Force
  Resolution: indefinite, approved for 0,1 N, individual calibration by sample and position (customised)
  Calibration accuracy: better than +/- 1% (officially approved)
- Fluid
  Volume approx.: 55l
  Level control: stainless steel float sensors and solenoid valves
  Temperature range: RT to 95 °C
  Accuracy: 1 °C
- Input pressure range for demin water supply
  0,2 - 8 bar (3 - 116 psi)
- Device interface
  Ethernet 10/100 M Base T
- Remote control
  WEB interface
- Size dimension
  (l, w, h) 143 x 81 x 113 cm
  Weight approx. 510 kg
- Power supply
  230 V AC, 50/60 Hz
- Temperature
  10 - 40 °C

Optional

- Computer
  Industrial Intel®Core™ 2 Duo
  Up-to-date-technology
- Software
  Operating system Windows XP Professional
  (latest technology)
- Physical interfaces
  [DC per external server]
  Ethernet 10/100/1000 M Base T, USB,
  RS 485, RS 232, digital & analogue I/O
- Communication protocol
  [DC per external server]
  MODBUS RTU, MODBUS TCP/IP, OPC, SQL,
  file transfer, PROFIBUS
  Implementation to other Fieldbus-Systems
  possible



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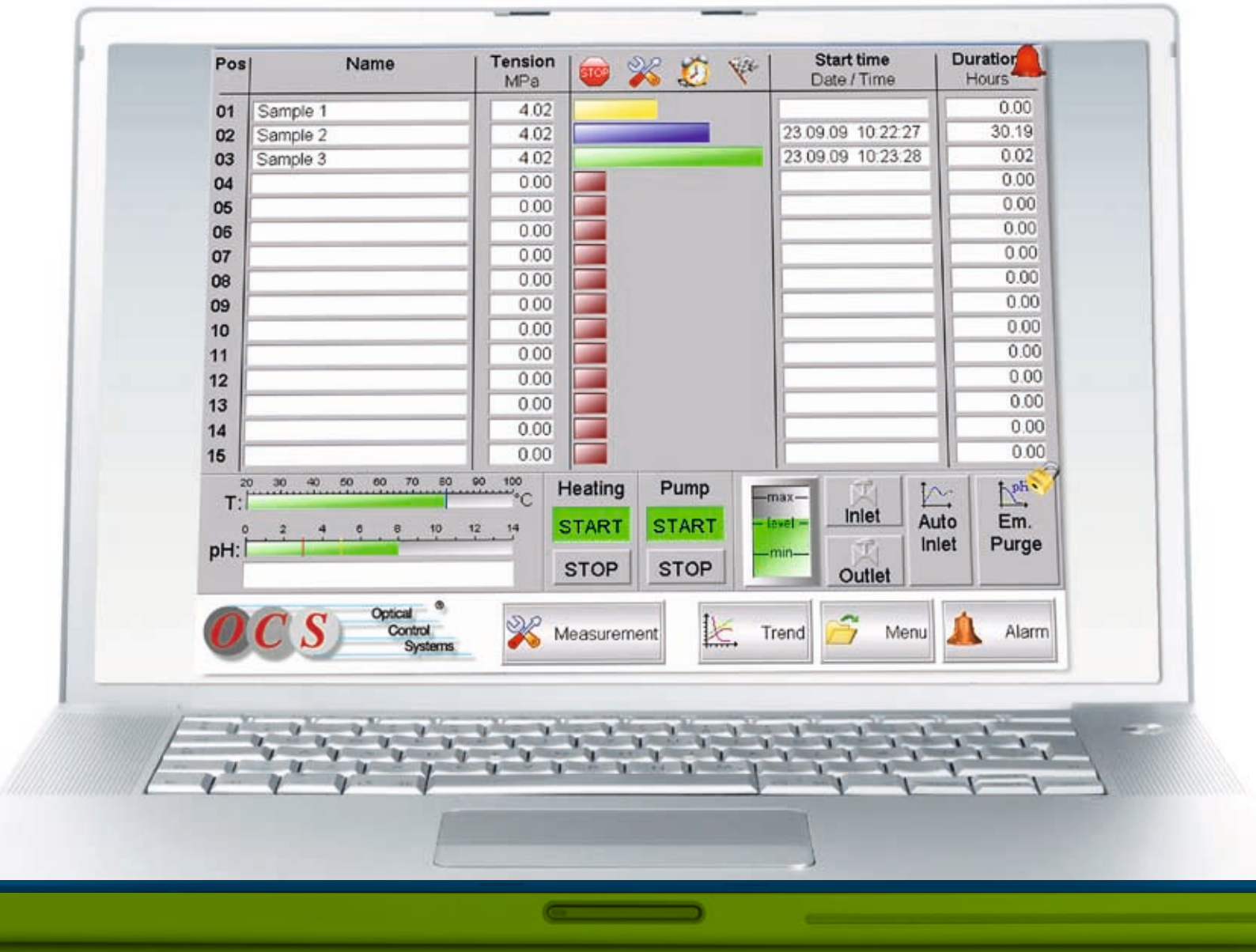

lyondellbasell

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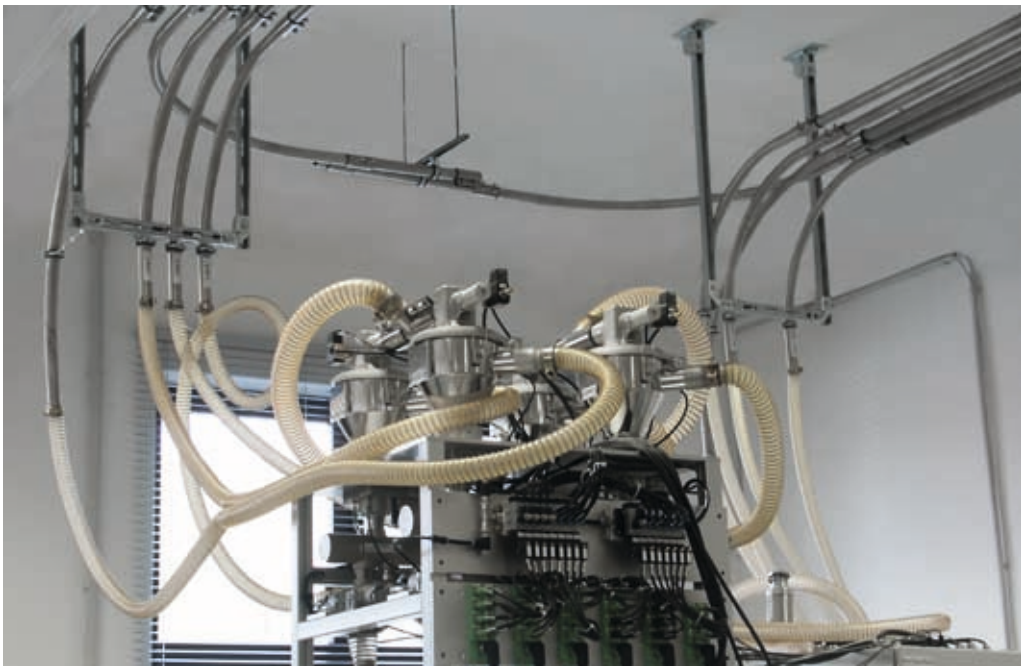
Cooperation LyondellBasell & OCS at Industriepark Frankfurt-Höchst

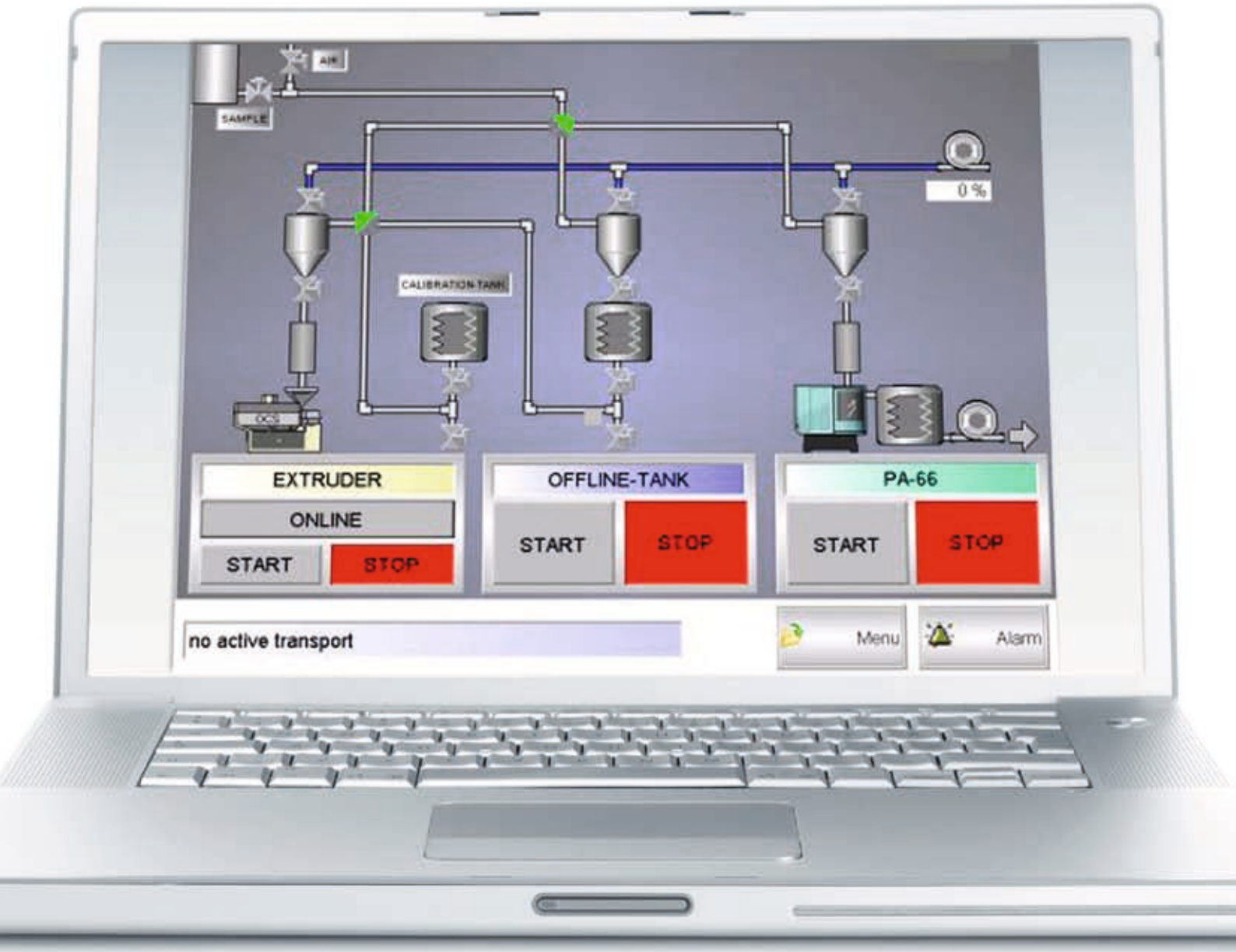
Pellet Transport System
PTS

The Pellet Transport System PTS is a continuous and automatic transportation of pellets between the production lines and measuring systems. Samples of pellets from the production line are affected by means of pneumatic sample takers. Samples are sent through aluminium or stainless steel pipes (shot peened option). The PTS consists of hopper loaders (cyclone) with shutter valves for extruder with low and high level sensors for sampling.

Furthermore a stand by tank for purge and calibration material and a 3 way switch for a starvation system is available. The PTS is controlled with a PLC which is driven with a TFT touch panel for visualisation and control of the sampling system. The system is equipped with a digital I/O interface to the DCS for transferring status and alarms.
All pipes and bends (elbows) are specified to avoid dust, angel hairs and streamers. Totally gap-free flange connections (recommended: slip-on collars and loose flanges with projection and recess).
A de-dusting device for removing dust and streamers etc. is an option.

Sample taker, 3 way switch and special hopper for extruder consist of:
Hopper loader (cyclone) with shutter valve for the analyser with low/high level sensors for sampling.





The following advantages can be achieved:

Constancy
- All the needed values are available every time
- The plant runs much more stabile
- Plant parameters are in the designated levels

On time readjusting
- Instantaneous intervention in case of parameter deviations
- Direct switch to “good” or “fail”–production
- Preventing huge amounts of scrap

Fast reaction
- Real-time reaction on parameter changing
- Short-time switch-over during transitions
- Scrap minimizing by immediate quality results

Remix/Transition
- Optimised plant flexibility by “remix”
- Conspicuous reduction of transition time
- Enabled to operate “advanced” transitions
- General increase of plant flexibility

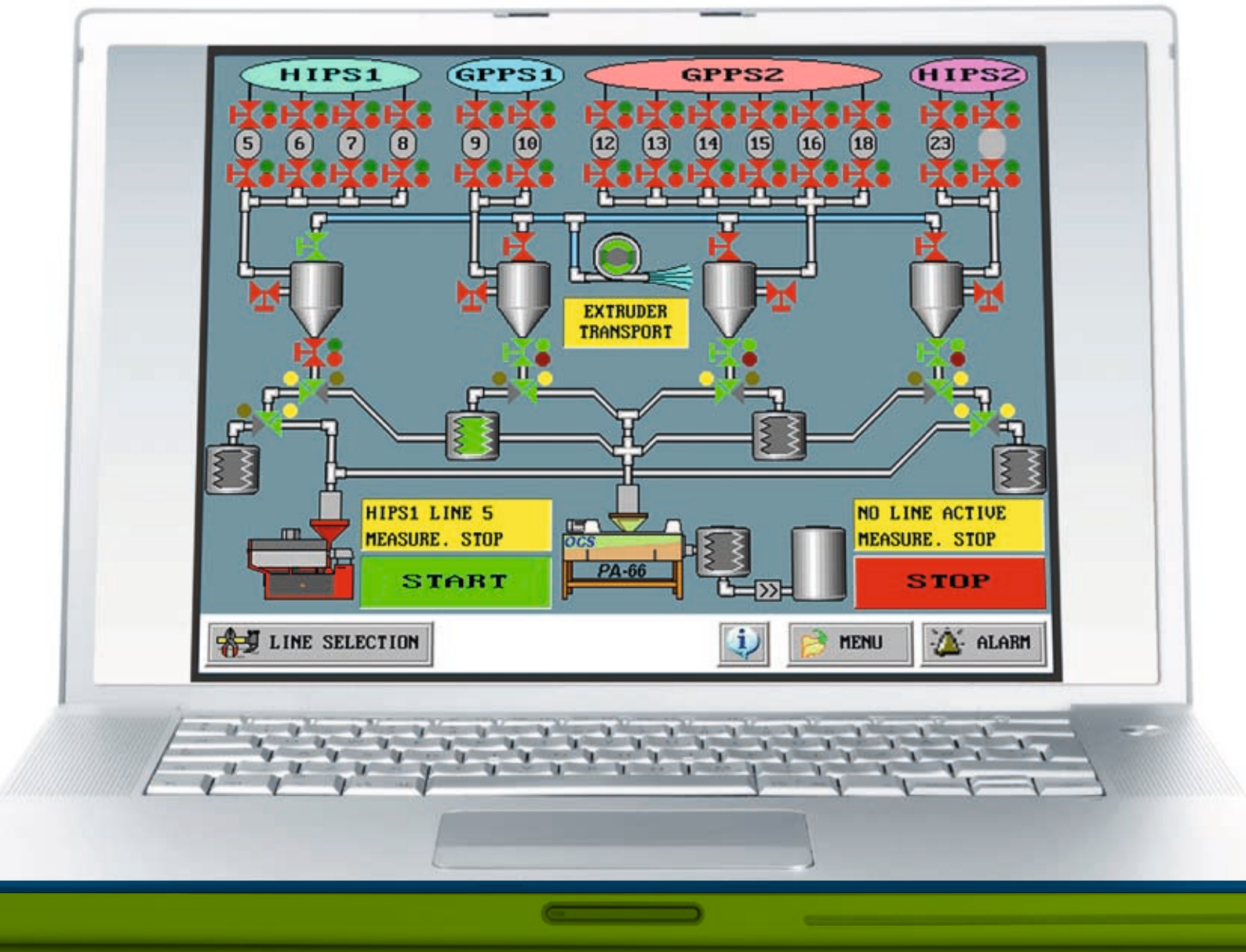
General plant overview
- Continuous data collection
- Statistics
- Process capability
- Increase of process CpK-values

Error prevention
- Preventing human errors
- Preventing miss-sampling
- Preventing analytical data transfer errors

Scrap minimising

By using OCS on-line equipment, scrap or substandard product can be minimised. Because of direct insertion of influence, the plant performance is increased significantly. Stabile operation conditions are obtained and boost product quality tremendous. The overall increased efficiency brings forward the plants absolute economics.

Parts of scrap or substandard can be reused or remixed because all parameters are under control permanently. That also will support the plants efficiency.



Direct results

- To get lab results can take up to 4 h time
- Plant operation values directly available
- Direct overview of plant situation

Direct handling

- All major analytical values are available anytime
- Cases of plant malfunctions are minimised
- Deviations from “normal” are observed directly and can be limited

Smooth operation

- Exceeding of analytical values are recognised soon and can be managed
- Overview on all parameters allow smooth operation at all times
- Direct parameter corrections keep the plant in stabile conditions

Optimised product mix

- Well known values allow flexible product changes
- Exact results are used for optimised product mix
- Campaigns of definated products easily can be prolonged or shortened

Perfect additive control

- Perfect control of stabiliser, slip agent, anti-block, antioxidant and other additives
- Additive limit settings or alarms
- Optimised additive consumption

Laboratory independency

- Reduced man power in lab
- Plant orientated operation
- Quality increase, because of preventing human errors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The application of our systems ranges from the laboratory to the complete integration into the production process.

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