

Plant optimisation, a service made by Polysius.



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Technologies

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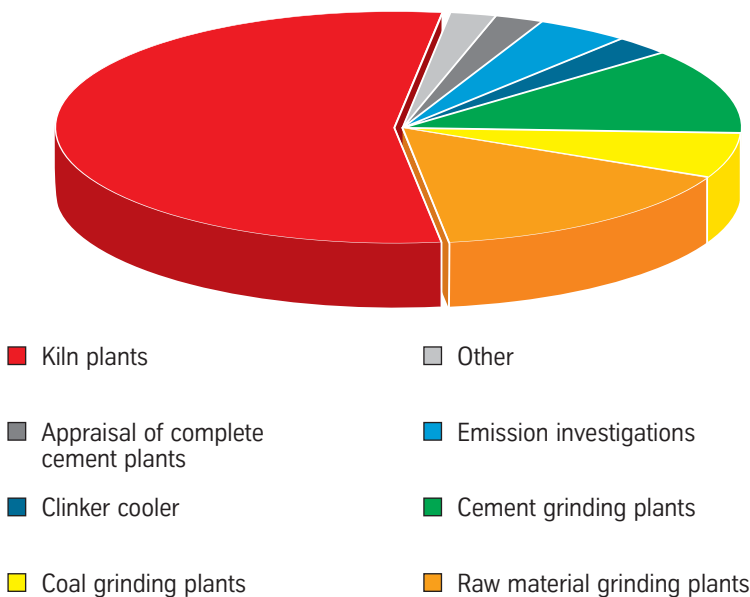


Plant optimisation made by Polysius...

Since 1985, Polysius has carried out more than 270 plant optimisations all around the world. Not only Polysius-built plants, but also plants supplied by other manufacturers have been purposefully analysed for weak points and successfully optimised.

The large number of performed plant optimisations proves that almost every production line holds substantial potential for maximising the performance and minimising the resource consumption.

Plant optimisations since 1985



Comprehensive knowledge of machines and plants is the essential prerequisite for quickly finding economical optimisation solutions.

As a leading provider of machines and plants, Polysius not only possesses this know-how but also has the advantage of being able to make thorough comparisons with other plants. Our customers thus receive a very broad range of information – a possibility which is not normally available to plant owners.



... a process technological service.

Our process engineering service – from advice on the spot to assistance during the implementation of technological improvement suggestions – has the following objectives:

- **reducing the operating costs**
- **increasing the production rate**
- **improving the product quality**
- **raising the plant availability**
- **enabling the use of secondary fuels and raw materials and**
- **reducing emissions.**

Recording the plant's current operating condition is the first step of every optimisation project. The further procedure, the precise definition of the task and the way in which the process engineering services are carried out depend on the individual requirements of the customer. Fundamentally, 3 service packages are available, each of which contains a different scope of service measures.

In **service package 1**, the relevant plant and process data are recorded on site and material samples are compiled as reference samples for the Polysius research laboratory. The samples are analysed and the data gained from their analysis and from other laboratory examinations are used for the generation of mass and energy balances. The customer receives the resulting documentation and expert advice in an on-the-spot meeting.

Service package 2 comprises the elaboration of detailed measures that will lead to a technological improvement. The possibilities for implementation of these measures are examined together with the respective specialist department and their effect is computed.

Service package 3 comprises the implementation of the technological improvement suggestions. Upon request, Polysius assigns expert personnel to assist with the optimisation work. If necessary, a concluding appraisal of the new plant situation is carried out after the measures have been implemented. Comparison with the appraisal before the optimisation was commenced provides an optimum evaluation of the performed measures.

Recognising potential...



Process technological analyses of process flows provide the basis for ascertaining the efficiency of overall processes or certain process sections. For this purpose, we not only use the traditional equipment, such as the ORSAT device and inclined tube manometer, but also newly developed, ultra-modern online measuring devices.

Measurement of characteristic process data:

- temperature
- pressure
- emissions
- mass flows
- flow rates
- material and gas compositions

Generation and evaluation of:

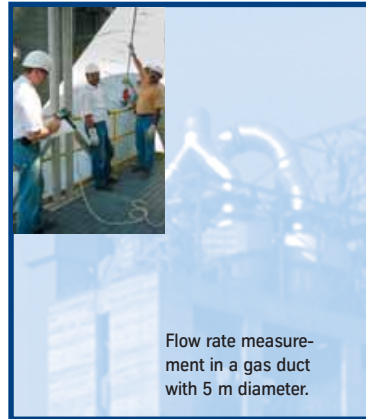
- mass
- gas and
- energy balances

Analysis of weak points through evaluation of measurement data and stoppage records.

Chemical and physical analysis of material samples

Testing of raw material and fuel samples

The Polysius research centre carries out an extensive range of material and process investigations on laboratory and semi-industrial-scales. Using the original material from the customer, processes can be simulated, weak points discovered and process technological optimisation measures developed.



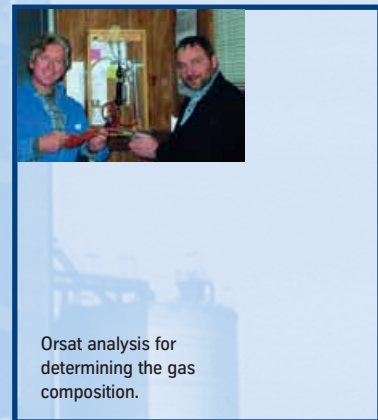
Flow rate measurement in a gas duct with 5 m diameter.



Orsat analysis for determining the gas composition.



Measurement with the thermo camera for determining heat losses.

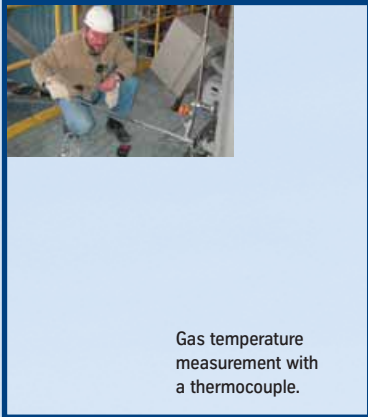


Measurement of the kiln shell temperature with the thermo camera for optimising the burner position and assessing the refractory lining condition.

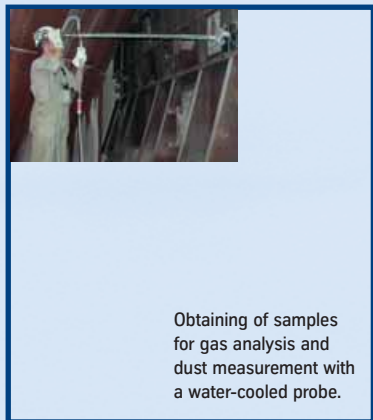


Mill optimisation in Malaysia 12/2001

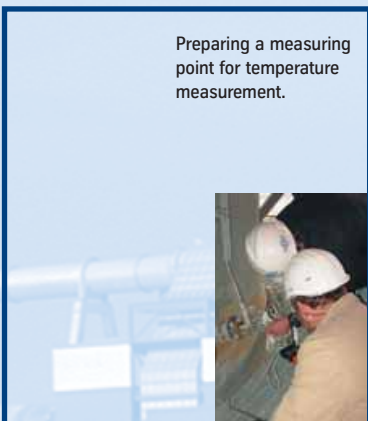
		before	after
Capacity	(tph)	129.2	141.1
Blaine fineness	(cm ² /g)	3050	3040
Spec. power consump.	(kWh/t)	39.3	35.6



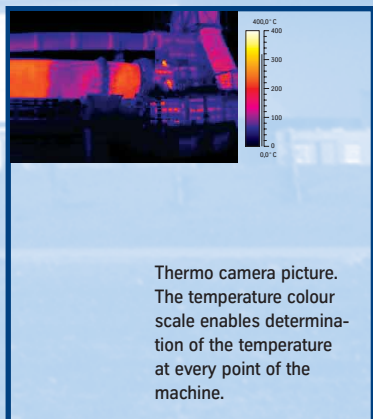
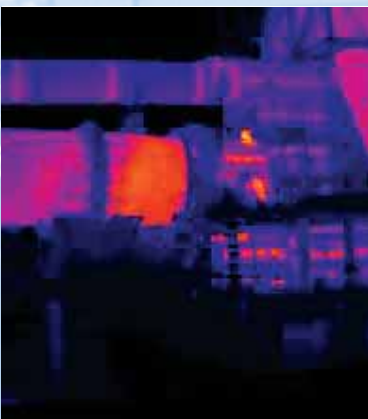
Gas temperature measurement with a thermocouple.



Obtaining of samples for gas analysis and dust measurement with a water-cooled probe.



Preparing a measuring point for temperature measurement.



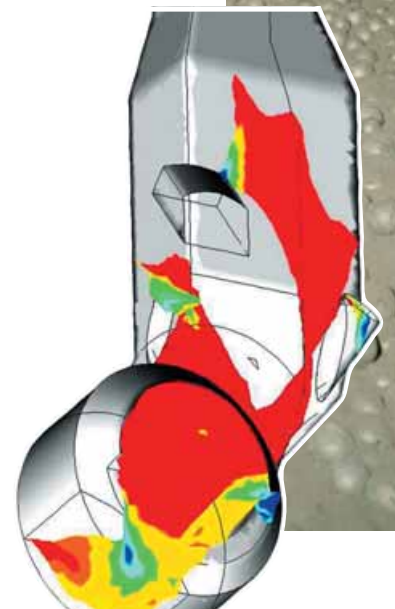
Thermo camera picture. The temperature colour scale enables determination of the temperature at every point of the machine.

Kiln line optimisation in Italy 08/2002		
	before	after
Kiln output (tpd)	3042	3600
Spec. fuel consump. (kcal/kgCli.)	820	803
Kiln rotation speed (rpm)	1.2	2.4
Fuel kiln/PC (%)	60/40	49/51
Exhaust gas temp. (°C)	430	417

On the basis of the test results, we produce a summarising test report with optimisation proposals. The effects of the optimisation measures on the process are realistically evaluated. If the plant owner decides to implement the proposed optimisation measures, Poly-sius can assign specialist engineers to assist in the work.

A further appraisal of the plant situation after the optimisation work has been performed provides a comparison of the conditions before and after the optimisation, thus enabling assessment of the optimisation results.

In many cases, the key to solution of specific problems is found by combining our comprehensive process-technological know-how with theoretical studies, for instance Computational Fluid Dynamics calculations (CFD) for simulating flow and temperature conditions.

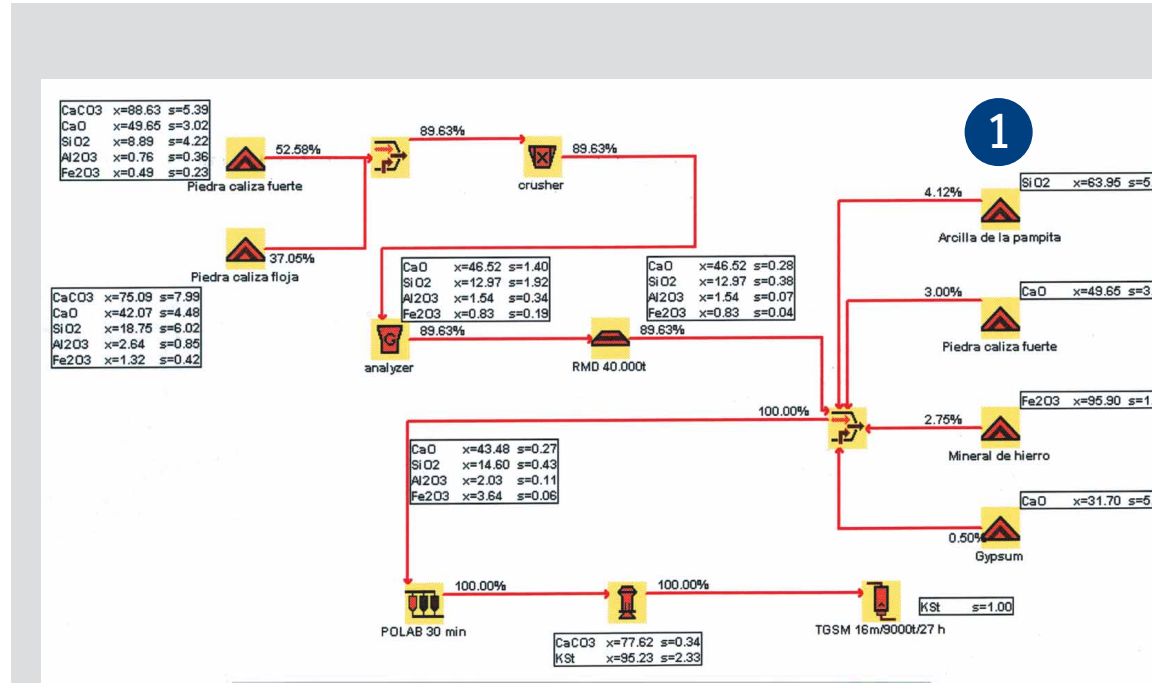


CFD calculation – a basis for the optimisation of flow conditions in every area of the plant.

Data evaluation – examples from different sectors.

The following data evaluation examples show the wide range of work undertaken:

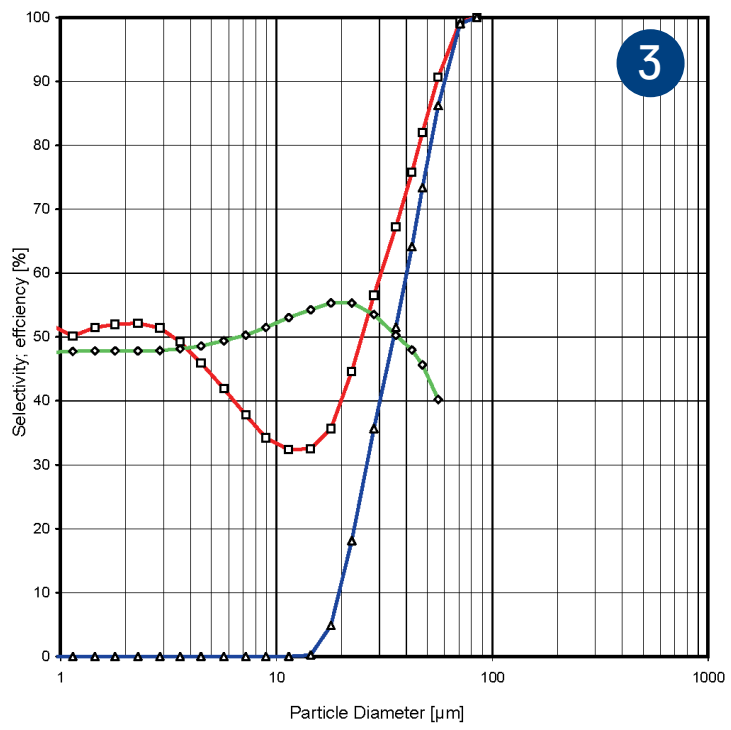
- 1) **ISAR**
homogeneity calculations for raw materials
- 2) **Tube mill**
ball grading
- 3) **Separator**
separator efficiency, Tromp curve
- 4) **Kiln plant**
heat balance
- 5) **Clinker cooler**
heat balance
- 6) **Bypass calculations**



BALL MILL: Ball charge, power consumption

Date: 10.2.2004
 Enquiry no.:
 Code word: 150-MDL
 Client: 2-Ch-Sep
 Remarks:

Product, Product fineness, Product quantity			Nominal dimensions and speed			
Product	Cement		D _{nom}	3,80 m	VTK D _{nom}	3,80 m
Product Fineness	3500 cm ³ /g		L _{nom}	12,50 m	VTK L _{nom} incl. wall	0,00
Product Quantity	75 t/h		n	3,269		
	Chamber 1	Chamber 2	Ch. 1+2	15,53 1/min	70,0 %/krit	
D ₁	3,64 m	3,64 m	11,65 m	Calculation c-Factor and power consumption		
L ₁	5,15 m	6,5 m		2-Ch-Sep Cem.	9,34 at FR 30%, n=Wu(Di)=31,7	
L/D ₁	1,415	1,786	3,201		0,9150 at n=Wu(Di) = 29,63	
Portion	44,2%	55,8%			1,0000 at Blaine = 3500 cm ³ /g	
Density ball charge	4,5 t/m ³	4,6 t/m ³	4,56 t/m ³		9,4033 at FR = 29,5%	
Filling ratio	28,0%	30,5%	29,5%	c-Faktor	8,604 m ³ /s	



POLYSIUS Exp 150

Quantity	Spars
9,01	0,0
5,01	0,0
3,01	0,0
12,01	0,0
28,01	0,0
19,01	0,0
18,91	0,0
0,01	0,0
94,91	0,0

1. Inputs

- Fuel, entering zone burner from sensible heat
- from combustion
- Raw material from sensible heat
- from combustive environment
- Cooling air from sensible heat
- Primary air from sensible heat
- Conveying air from sensible heat

Total inputs

2. Expenditures

- Theoretical heat requirement for clinker burning
- Water evaporation, kiln feed
- Exhaust gas losses
- Losses by U11
- Losses by exhaust gas dust
- Dehydration of exhaust gas dust
- Losses by cooler exhaust air
- Clinker waste heat losses
- Radiation and Convection
- Remainder

Total Expenditures

Examples of optimisation measures

Kiln and preheater

- reducing exhaust gas losses
- reducing heat losses in the cooler system
- optimising the burner parameters
- reducing dust losses downstream of the preheater
- reducing pressure drops
- analysing coating conditions
- reducing false air by replacing the kiln inlet/kiln outlet seals
- improving the cyclone efficiency by installing new dip pipes
- installing dispersing boxes in the preheater
- reducing circulating volatile impurities

Silo

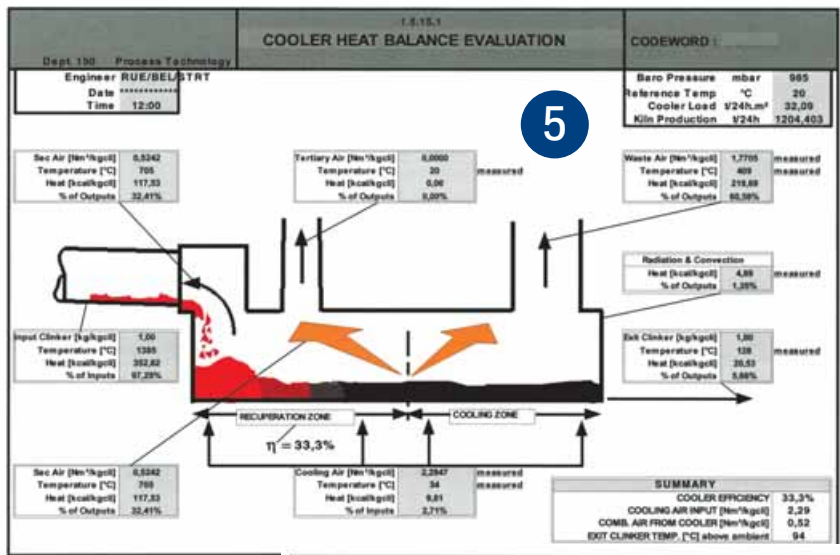
- optimising the aeration conditions
- optimising the blending time of batch silos
- optimising the filling parameters
- optimising the filling level of the central chamber

Grinding plants

- optimising the material feeding
- spring characteristic (high-pressure grinding roll hydraulic system)
- optimising the separator guide vane setting
- optimising the ball grading
- reducing the spec. power requirement
- optimising the smooth running (high-pressure grinding rolls, roller mills)
- adapting the material recycle ratio (separator material circuits)
- adapting the dam ring height in roller mills
- utilising the installed drive power
- optimising the raw meal quality (moduli, fineness)
- optimising the cement quality (water demand, sulphate bearer optimisation)

General

- training of operating personnel
- optimising the measurement and control circuits
- stabilising the plant operation



Heat balance of the complete kiln at 20 °C

	kgcl/kg cl.	kj/kg cl.
1	30,0 t/h	1,4
K	11,10 t/h	913,8
R	1,8364 kg/kg cl.	19,2
C ₁	0,0042 kg/kg cl.	74,2
V ₁	2,2947 Nm ³ /kg cl.	9,8
V ₂	0,6779 Nm ³ /kg cl.	2,1
V ₃	0,0598 Nm ³ /kg cl.	0,9
from fuel		913,8
		3425,9
		1020,5
		143,0
H ₂ O	0,27 t/h	2,9
V ₄	1,8310 Nm ³ /kg cl.	201,8
C ₂	0,32 t/h	16,4
V ₅	27,0 t/h	21,3
q ₆	8,7 t/h	12,1
V ₇	1,2705 Nm ³ /kg cl.	270,0
V ₈	40,8 t/h	20,5
V ₉	1,28 t/h	0,7
V ₁₀	26,4 t/h	26,4
		1020,5
		4272,5
		100,00