

- Sinter handling
- Mixing drum moisture control
- Hood temperature and pressure control
- Calorific value control of ignition hood fuel gas
- Burn-through point control
- Main fan suction and waste gas overtemperature control
- Cooler speed control

## Sinter plant Application Note

The function of the Sinter Plant is to supply the blast furnaces with sinter, a combination of blended ores, fluxes and coke which is partially 'cooked' or sintered. In this form, the materials combine efficiently in the blast furnace and allow for more consistent and controllable iron manufacture. Figure 1 shows a simplified diagram of a sinter plant.

Materials enter the sinter plant from storage bins. They are mixed in the correct proportions using weigh hoppers, one per storage bin, except for the return fines for which an impact meter is used instead. Weighing is continuous, as is the whole sintering process. The weighed materials pass along a conveyor to the mixing drum where water is added either manually or as a calculated percentage of the weight of material entering the drum.

The moisture content of the coke is measured in the strand roll feed hopper and used to trim the secondary water flow rate. The mix permeability is also measured and used to modify the amount of water required.

The mix material is fed onto the strand from the hopper by a roll feeder. The bed depth is set and kept constant by adjusting the cut-off plate which is fitted with probes to sense the depth of material and automatically vary the roll feeder speed. The quantity of material in the feed hopper itself is held constant by automatic adjustment of the feed rates from the individual raw material bins.

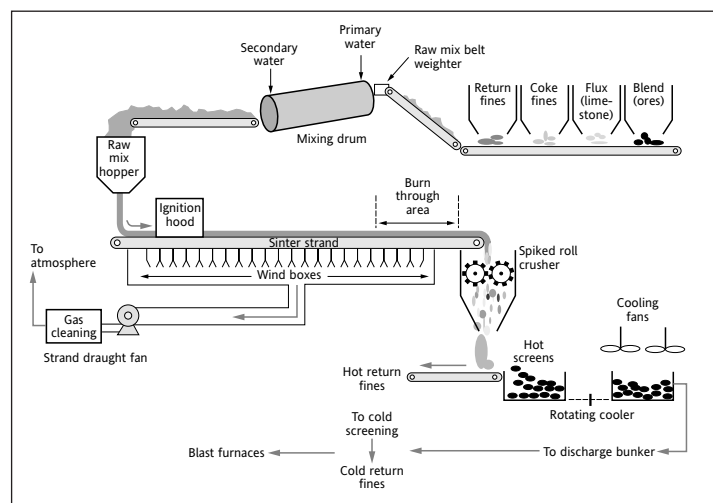


Figure 1 Simplified diagram of a sinter plant

### Sintering

The raw mix is ignited by the ignition hood, which is fuelled by a mixture of coke oven gas, blast furnace gas and sometimes natural gas. The calorific value of the mixture and the set hood temperature are controlled. A separate control system is provided to maintain a fixed hood pressure by adjusting the windbox dampers immediately under the ignition hood.

The sinter strand is a moving conveyor of hot sinter, which continues to 'cook' after leaving the hood, where air is pulled from the sinter by a strand draught fan.

An important part of the sintering process is burn-through. This is where the sinter layer has completely burned through its section and is detected by temperature probes under the sinter bed. Burn through should be achieved but must not occur too soon after the ignition hood. The draught on the strand is maintained at a preset value by controlling the main fan louvers from pressure measurements in the wind main. This governs the point at which burn through occurs.

### Sinter handling

After the end of the strand, the sinter passes through a spiked roll crusher and the hot screens to the rotating circular cooler. A number of fans are usually used for cooling, and the speed of the cooler is determined by

- Strand speed
- Bed depth

The fines removed by the hot screens are conveyed to the return fines bin.

After cooling, the sinter is passed into the discharge bunker. At this stage, the level is controlled by varying the outlet feed rate (usually vibros).

The sinter then passes to the cold screening area, where it is passed through crushers and screens to produce particles in a specific size range. Sinter below the required size passes over a belt weigher and returns with the hot fines to the return fines bin.

The difference between the weight of the cold fines, and the weight of the total fines produced, gives a measure of the hot fines. Any abnormal variation in the rate of production of hot or cold return fines indicates a possible plant fault.

The following factors can affect the rate at which fines are produced

- Mix control
- Particle size
- Chemistry
- Weight
- Moisture content
- Bed depth
- Ignition hood temperature and pressure
- Warm screens

Two important properties of sinter are basicity, which is controlled by the amount of limestone, and strength, which is controlled by coke content.

The sinter is now suitable for use in the blast furnace. Conveyors transport the material to the blast furnace stock house, where it is added to other materials to form the blast furnace burden.

### Mixing drum moisture control

The amount of primary water added is proportional to the weight of raw mix entering the mixing drum. This can be easily achieved using a Eurotherm Process Automation control module as shown in Figure 2.

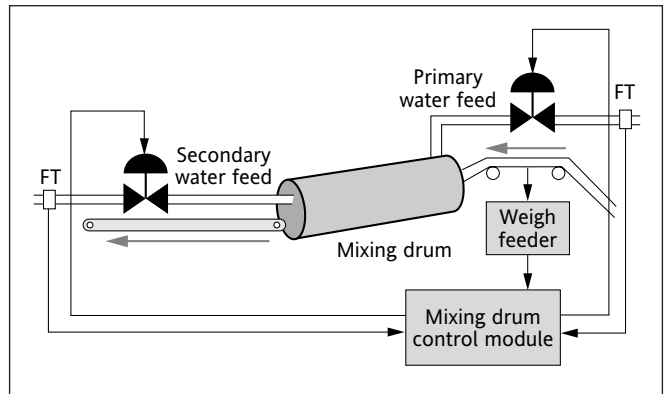


Figure 2 Mixing Drum Moisture Control

The secondary water feed setpoint is frequently taken as a proportion of the raw mix belt weigher PV. For greater accuracy, the moisture meter reading is used to trim the material/water ratio. This corrects the water flow rate according to the measured moisture content of the raw mix.

Cascade control is not always used but since the water flow loop responds faster than the moisture loop it does produce better results.

### Ignition hood temperature control

Figure 3 depicts the implementation of ignition hood temperature control with options for the control ratio.

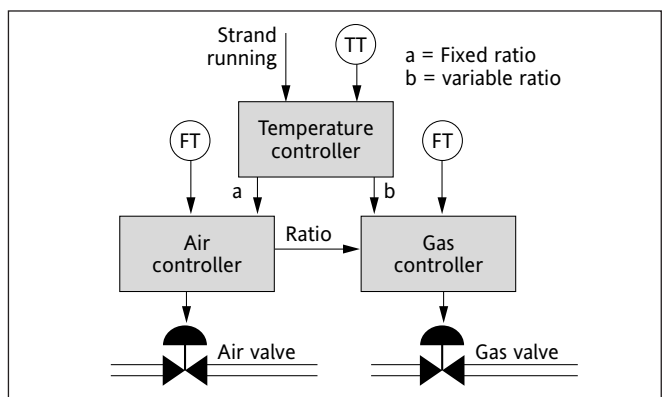


Figure 3 Ignition Hood Temperature Control

With the fixed ratio air lead temperature control, the temperature demand provides a setpoint for the air flow. The fuel follows the air flow in a fixed ratio making this a fuel efficient method.

On the other hand, with variable ratio air lead temperature control, the air flow is fixed and the hood temperature controller output (the heat demand signal) feeds the ratio setpoint trim input of the gas controller. This method is normally used when there is a readily available source of cheap fuel e.g. blast furnace gas.

### Ignition hood pressure control

This is normally achieved by varying the setting of dampers in the windboxes under the ignition hood. A single loop PID controller is generally used to automatically maintain the pressure at a desired value.

### Calorific value control of ignition hood fuel gas

Blast furnace gas and coke oven gas are used to fuel the ignition hood burners. The calorific value of the fuel is controlled to a consistent value by a separate control loop. If the strand stops, a digital signal forces the ignition hood into a 'low fire state' and holds it there until the strand re-starts.

It is easier to keep the ignition hood temperature constant if the calorific value of the fuel is controlled to within pre-defined limits, about 4,000 - 6,000 kJ/m<sup>3</sup>. By mixing coke oven gas with blast furnace gas, this calorific value is achieved. Figure 4 shows the calorific value control strategy.

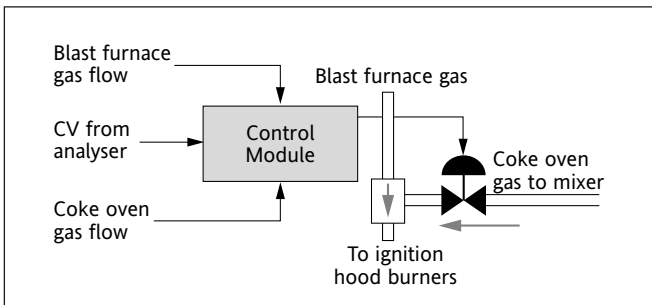


Figure 4 Calorific Value Control of Ignition Hood Fuel Gas

### Burn-through point control

Burn-through point should ideally occur near the end of the strand bed. It is controlled by altering the strand speed. A number of variables will affect the burn-through point, such as strand bed depth, water content and the quality of the sinter.

The strand speed is either controlled manually, or by measuring the waste gas temperatures as an indication of the burn-through point. If it occurs too early, the average waste gas temperature rises. If it occurs too late, the waste gas temperature decreases and the strand speed is slowed to compensate.

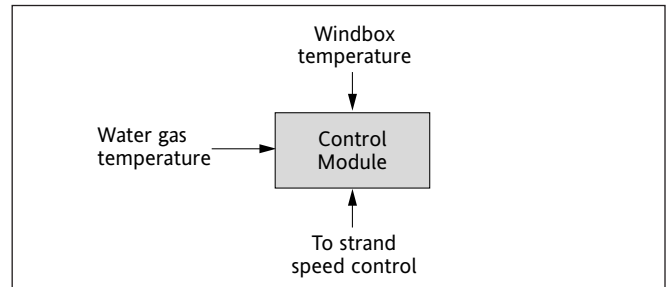


Figure 5 Burn-Through Point Control

Windbox temperatures can be used to improve the monitoring and are added as a setpoint bias. Figure 5 shows this in the control strategy.

### Main fan suction and waste gas overtemperature control

The suction produced by the main fan is varied by louvers near the fan inlet, which are controlled by a fan suction controller. If the waste gas temperature increases above a safe working limit a selector switch allows the waste gas overtemperature controller to position the louvers.

### Cooler speed control

After leaving the strand, the hot sinter is cooled on a rotary cooler. The speed of the rotary cooler is controlled to match the strand demand defined by the bed depth and the strand speed.

**For information on this application or to review other Heat Treatment applications available from Eurotherm, please visit our website at [www.eurotherm.com](http://www.eurotherm.com) or contact us directly as detailed over the page.**

---

## Eurotherm: International sales and service

Understanding and providing local support is a key part of Eurotherm's business. Complementing worldwide Eurotherm offices are a whole range of partners and a comprehensive technical support team... a soothing melody to ensure you get a service you will want to go back to.

### **AUSTRALIA** Sydney

Eurotherm Pty. Ltd.  
Telephone (+61 2) 9838 0099  
Fax (+61 2) 9838 9288  
E-mail [info@eurotherm.com.au](mailto:info@eurotherm.com.au)

### **AUSTRIA** Vienna

Eurotherm GmbH  
Telephone (+43 1) 7987601  
Fax (+43 1) 7987605  
E-mail [eurotherm@eurotherm.at](mailto:eurotherm@eurotherm.at)

### **BELGIUM & LUXEMBURG** Moha

Eurotherm S.A/N.V.  
Telephone (+32) 85 274080  
Fax (+32) 85 274081  
E-mail [info@eurotherm-belgium.be](mailto:info@eurotherm-belgium.be)

### **BRAZIL** Campinas-SP

Eurotherm Ltda.  
Telephone (+5519) 3707 5333  
Fax (+5519) 3707 5345  
E-mail [eurothermltda@eurothermltda.com.br](mailto:eurothermltda@eurothermltda.com.br)

### **DENMARK** Copenhagen

Eurotherm Danmark AS  
Telephone (+45 70) 234670  
Fax (+45 70) 234660  
E-mail [info@eurotherm.se](mailto:info@eurotherm.se)

### **FINLAND** Abo

Eurotherm Finland  
Telephone (+358) 22506030  
Fax (+358) 22503201

### **FRANCE** Lyon

Eurotherm Automation SA  
Telephone (+33 478) 664500  
Fax (+33 478) 352490  
E-mail [ea@automation.eurotherm.co.uk](mailto:ea@automation.eurotherm.co.uk)

### **GERMANY** Limburg

Eurotherm Deutschland GmbH  
Telephone (+49 6431) 2980  
Fax (+49 6431) 298119  
E-mail [info@regler.eurotherm.co.uk](mailto:info@regler.eurotherm.co.uk)

### **HONG KONG & CHINA**

Eurotherm Limited North Point  
Telephone (+85 2) 28733826  
Fax (+85 2) 28700148  
E-mail [eurotherm@eurotherm.com.hk](mailto:eurotherm@eurotherm.com.hk)

#### *Guangzhou Office*

Telephone (+86 20) 8755 5099  
Fax (+86 20) 8755 5831

#### *Beijing Office*

Telephone (+86 10) 6567 8506  
Fax (+86 10) 6567 8509

#### *Shanghai Office*

Telephone (+86 21) 6145 1188  
Fax (+86 21) 6145 1187

### **INDIA** Chennai

Eurotherm India Limited  
Telephone (+91 44) 24961129  
Fax (+91 44) 24961831  
E-mail [sales@eurothermdel.com](mailto:sales@eurothermdel.com)

### **IRELAND** Dublin

Eurotherm Ireland Limited  
Telephone (+353 1) 4691800  
Fax (+353 1) 4691300  
E-mail [info@eurotherm.ie](mailto:info@eurotherm.ie)

### **ITALY** Como

Eurotherm S.r.l  
Telephone (+39 31) 975111  
Fax (+39 31) 977512  
E-mail [info@eurotherm.it](mailto:info@eurotherm.it)

### **KOREA** Seoul

Eurotherm Korea Limited  
Telephone (+82 31) 2738507  
Fax (+82 31) 2738508  
E-mail [help@eurotherm.co.kr](mailto:help@eurotherm.co.kr)

### **NETHERLANDS** Alphen a/d Rijn

Eurotherm B.V.  
Telephone (+31 172) 411752  
Fax (+31 172) 417260  
E-mail [sales@eurotherm.nl](mailto:sales@eurotherm.nl)

### **NORWAY** Oslo

Eurotherm A/S  
Telephone Oslo (+47 67) 592170  
Fax (+47 67) 118301  
E-mail [info@eurotherm.se](mailto:info@eurotherm.se)

### **SPAIN** Madrid

Eurotherm España SA  
Telephone (+34 91) 6616001  
Fax (+34 91) 6619093  
E-mail [ventas@iberica.eurotherm.co.uk](mailto:ventas@iberica.eurotherm.co.uk)

### **SWEDEN** Malmo

Eurotherm AB  
Telephone (+46 40) 384500  
Fax (+46 40) 384545  
E-mail [info@eurotherm.se](mailto:info@eurotherm.se)

### **SWITZERLAND** Freienbach

Eurotherm Produkte (Schweiz) AG  
Telephone (+41 55) 4154400  
Fax (+41 55) 4154415  
E-mail [epsag@eurotherm.ch](mailto:epsag@eurotherm.ch)

### **UNITED KINGDOM** Worthing

Eurotherm Limited  
Telephone (+44 1903) 268500  
Fax (+44 1903) 265982  
E-mail [info@eurotherm.co.uk](mailto:info@eurotherm.co.uk)  
Web [www.eurotherm.co.uk](http://www.eurotherm.co.uk)

### **U.S.A.** Leesburg VA

Eurotherm Inc.  
Telephone (+1 703) 443 0000  
Fax (+1 703) 669 1300  
E-mail [info@eurotherm.com](mailto:info@eurotherm.com)  
Web [www.eurotherm.com](http://www.eurotherm.com)

ED48

---

© Copyright Eurotherm Limited 2006

Invensys, Eurotherm, the Eurotherm logo, Chessell, Mini8 and Wonderware are trademarks of Invensys plc, its subsidiaries and affiliates. All other brands may be trademarks of their respective owners.

All rights are strictly reserved. No part of this document may be reproduced, modified, or transmitted in any form by any means, nor may it be stored in a retrieval system other than for the purpose to act as an aid in operating the equipment to which the document relates, without the prior written permission of Eurotherm limited.

Eurotherm Limited pursues a policy of continuous development and product improvement. The specifications in this document may therefore be changed without notice. The information in this document is given in good faith, but is intended for guidance only. Eurotherm Limited will accept no responsibility for any losses arising from errors in this document.

