Application Note AN0602
Explanations and Considerations about Multizone Controllers

_____

1.) Applications for Multizone Controllers

On large size kilns it is often difficult to obtain equal temperatures in the kiln chamber. Although thermal heat convection tends to equalize temperatures differences of 20°K or even more were found due to unequal heating elements radiation and gaps in the door seals etc.

To achieve total temperature equalization the usage of a multizone control is mandatory. To use a multizone controller the kiln must be electrically devided into separate zones, ie. each zone fitted with a thermocouple and an independently operable set of the heating elements.

The controller acquires the temperature of each zone, compares it with the programme setpoint and drives the corresponding set of heating elements accordingly. This ensures highest temperature equalization.

2.) Specifying Different Zone Temperatures

A multizone controller can also be used to obtain different temperatures in the zones. The enables of the operator to perform special heat treatment processes. This feature is available on controller models TC-M2 and TC-S1 (not on TC500 controllers). You can specify the required zone temperature for each programme segment seperately. Depending on the application the zone temperature is entered either as absolute value or as relativ temperature (offset or bias) refering to the programm temperature.

3.) Limitations

A multizone kiln resp. controller can not overcome the physical limitations of the kiln. If a particular zone lags behind the setpoint although it is on full power, the controller has no options to counteract. However, the bentrup controllers have a process control feature which will hold the programme once this situation occurs (see chapter 6.) for details).

4.) Can I control Multiple Kilns with one Multizone Control ?

This questions comes up quite often. Yes, you can - but in most applications it does not make sense: A multizone system controls the zones with one programme. You enter one programme, ie. one programme cycle is processed one segment after the other. If you have e.g. 3 kilns in your production and want to fire them simultaneously as well with the same kind of programme then you can do this with a 3 zone multizone control. But keep in mind that if one kiln lags behind in temperature this will slow down the other kilns as well. Of course you can not start the programmes seperately for each kiln since there is only one common programme cycle.

5.) Is there a Master or Primary Zone ?

Basically no ! The controller calculates the programme setpoint. This setpoint (if not modified by an offset as described in 2.) is taken as setpoint for each zone.

Depending on the application you can emphasize some zones more than others. This affects the controllers operation on zone errors (heatup problems etc). Please see chapter 6.) for details.

The following example demonstrates that there might be a configuration where it is important to fully understand the controllers operation (only applies on TC-S1 and TC M2):
Assuming a configuration for a 3 zone control where all zones are defined by a separate absolute value. The programme table could look like this:

Segment	Time	Temp Zone 1	Temp Zone 2	Temp Zone 3
0	SKIP	0°C	0°C	0°C
1	2:00	820°C	500°C	500°C
2	1:00	540°C	520°C	520°C
3	3:00	450°C	0°C	0°C

In this example there are two details which could cause confusion:

1.) In Segment 2 temperature in zone 1 drops from 820°C downto 540°C within 1:00 hour. But the direction of the temperatures in zones 2 and 3 is the other way around (from 500°C to 520°C). The controller understands this segment 2 as **cooling** segment (since this is the direction of the first column of the programme table, zone 1 in this example). Therefore the controller will not wait on entering the next segment if the temperature in zone 2 or 3 is too low (since in a cooling segment the controller waits for the temperature to drop). Same situation vice versa if zone 1 is a heating segment and zones 2 and 3 require temperature decrease.

2.) In Segment 3 it looks that heating will stop right away since requested temperature is 0°C. But it will not ! The controller understands segment 3 in zone 2 and 3 as "from 520°C to 0°C within 3:00 hours". If you want to turn off zones 2 and 3 you need to enter a new segment before segment 3 with "SKIP / 540°C/ 0°C/0°C" (the controller will skip this segment and take the proper values for the next segment).

6.) Does the Controller care if one or more Zones are unable to follow the Temperature ?

As you like ! Please refer to the explanation of the corresponding configuration section (table "process flow control" on TC-S1/M2 or parameter 9 on TC500 controller series). Depending on the application it might be desired that that the controller waits during a ramp if particular zones loose tracking.

7.) Using SKIP

Keep in mind that SKIP causes uncontrolled ramps. This means that all zones will be set to full power resp. minimum power. As a consequence there will be differences in temperature between the zones since heating resp. cooling capability most likely differs from zone to zone.

If you request equal temperatures between the zones at all times use a fast ramp instead of skip. If you set the corresponding parameters ("process flow control" on TC S1/M2 resp. parameter 9 on TC500 series controllers) accordingly the controller will slow down the ramps automatically. Since frequent "holds" will be inserted to give the lagging zones the chance to catch up the total time of the segment will be much longer than on a SKIP segment.

8.) Parameter "process flow control" (TC-S1/M2) resp. parameter 9 (TC500 series)

To understand the various options and features of the process flow control please refer to the corresponding explanation of the parameters in the controllers manual. It is important to understand the features, the options and the current setting to be able to follow the controllers reaction.

Initial Issue	June 20th 2002	Be
Updated		