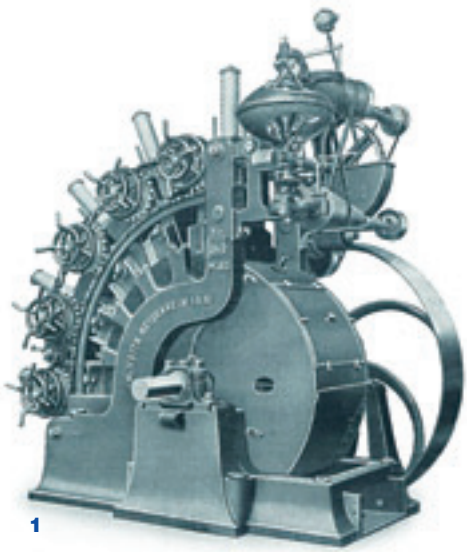

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# New grinders from old –
## Automation of 50-year-old Stone Grinders

**Voith Paper recently received an order from VIPAP in Krsko, Slovenia, for converting seven continuous grinders to TGW (Thermo Ground Wood) grinders. In the course of modernizing their raw materials supply system, VIPAP will concentrate on groundwood and DIP in future, because pulp production has been stopped for environmental legislation reasons.**

The scope of supply includes not only TGW installations and rebuild components, but also the process control and C&I engineering, complete automation and various services such as erection supervision and commissioning.

Wood grinders have a long life! Although these old machines type IIIET and VET date back to 1952-1962, their output after rebuild will reach 170 t/day of high quality groundwood.

The stone groundwood process produces characteristics of fines that are essential for meeting paper surface requirements. Therefore, groundwood is a very important raw material for the paper industry.

### History of stone grinders (Fig. 1)

The first stone grinders in Germany date back to 1852. Over the next 150 years they were continuously improved to increase production output and enhance stock quality. The basic principle, however, has remained practically unchanged: wood is pressed against a rotating grindstone, whose surface is cleaned and cooled by water simultaneously. Out of the different kinds of grinders developed in the meantime, only the chain grinder, operating at atmospheric pressure, ensures a continuous groundwood output. This type of grinder was developed in 1919 by Voith and was first used at the Schongau paper mill, Germany, in 1921.

### Grinder automation (Fig. 2)

Grinder automation centers on a Simatic S7-414-3DP programmable logic control (PLC) with 800 input/output signals for process interface. In total, 270 electrical and C&I control loops are programmed and visualized on 20 operator displays. The monitoring is carried out on a PC workstation using WinCC visualization software. Comprehensive new instrumentation for the grinder and periphery is included in the scope of supply. The seven grinders are now controlled entirely from the operator station.

This new automation system includes the following features:

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**Fig. 1:** *The first Voith stone grinder.*

**Fig. 2:** *Overview of grinder automation system.*

**Fig. 3:** *Grinding process control display.*

| | Production output | Grinding quality |
|---|---|---|
| Constant power control | + + + + | + |
| Constant production control | + + + | + + |
| TGW control | + + | + + + |

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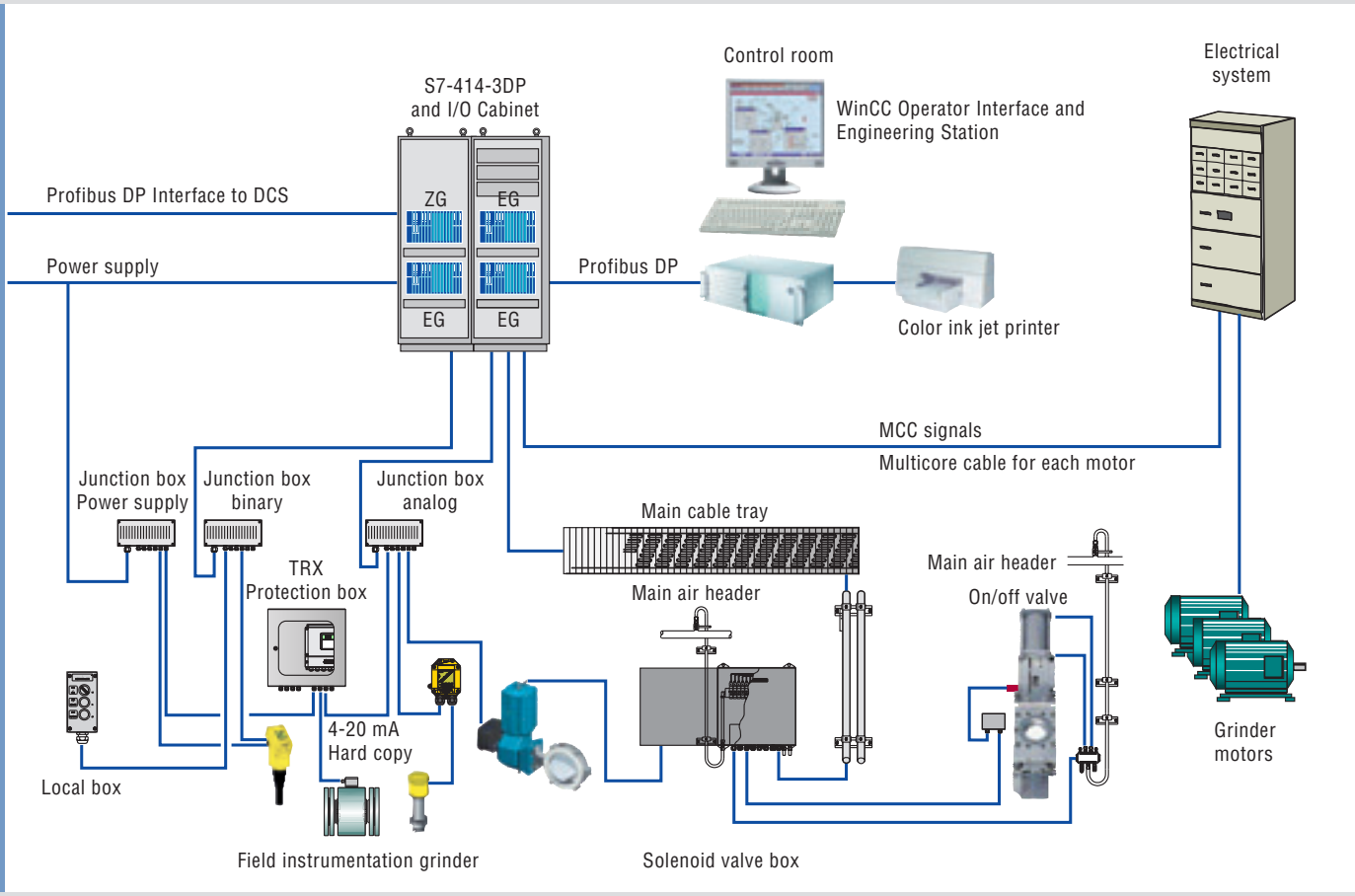


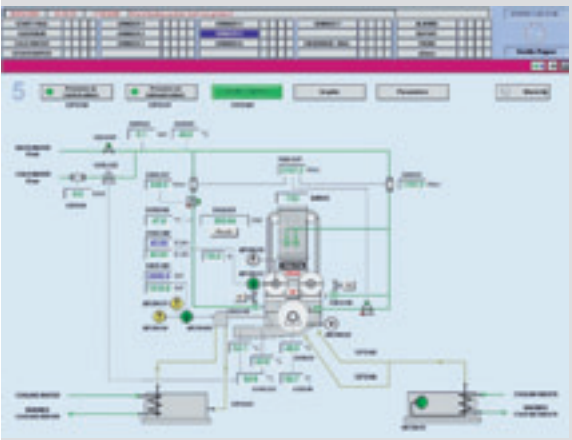

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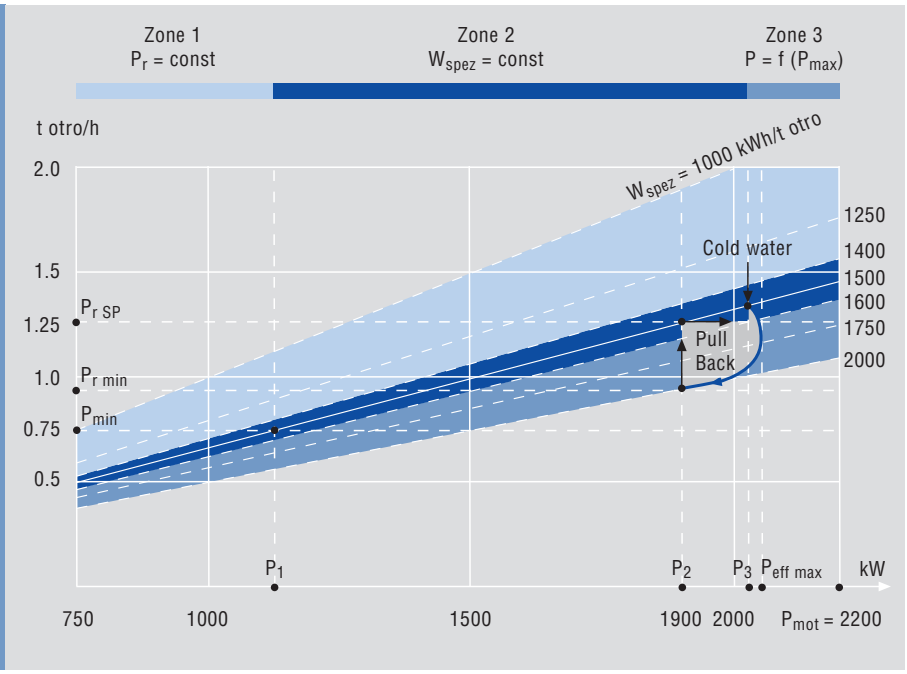
- Automated group start and stop of each grinder
- Control displays for the grinders and for the water supply system
- Individual control per Electrical and C&I loop via OCX multitasking windows
- Trend display and reporting system with energy reporting
- Alarms and diagnostics for the control system
- eDoxx online documentation system at the operator station for mechanical, electrical and C&I documentation
- Three control programs with specific parameter display, as described below **(Fig. 3)**.

There are three kinds of control mode:

- Constant grinder power control
- Constant production control (measured in tons oven-dry/24 h)
- TGW control for constant specific energy (in kWh/t.o.d.).

**Fig. 4:** *Continuous grinder control chart.*




The table on page 65 above compares these three control modes in terms of production output and quality, where the number of "+" signs indicates the respective weighting.

TGW control mode is the best solution with regard to consistent groundwood quality, followed by constant production control. In most cases constant power control is only used where high production rates are the main requirement.

What is TWG control mode?
TWG control mode is based on constant specific energy consumption ($W_{spec}$). Continuous measurements of power consumption and calculation of the production rate are indispensable for precisely determining the specific energy consumption.

Grinder operating behaviour can be divided into three typical zones (Fig. 4).

**Zone 1:** $P_{eff} < P_1$
Operation at constant feed. Specific energy consumption $W_{spec.calc}$ is below the $W_{spec\ SP}$ setpoint because the power consumption is too low or the grindstone is too sharp. In this zone the grinder is, therefore, operated at constant feed $P_{r\ min}$. This condition usually occurs after grindstone sharpening, and constant feed mode enables troublefree transition back to normal operating condition (Zone 2).

**Zone 2:** $P_1 < P_{eff} < P_3$
TGW control mode ($W_{spec}$).
Both output and power consumption exceed the parameter settings $P_{r\ min}$ and $P_1$ in this zone, where constant $W_{spec}$ control is used. The power setpoint value $P_2$, calculated from the desired production rate and the necessary energy consumption, is an important control parameter here for correlating feed chain speed and production rate.

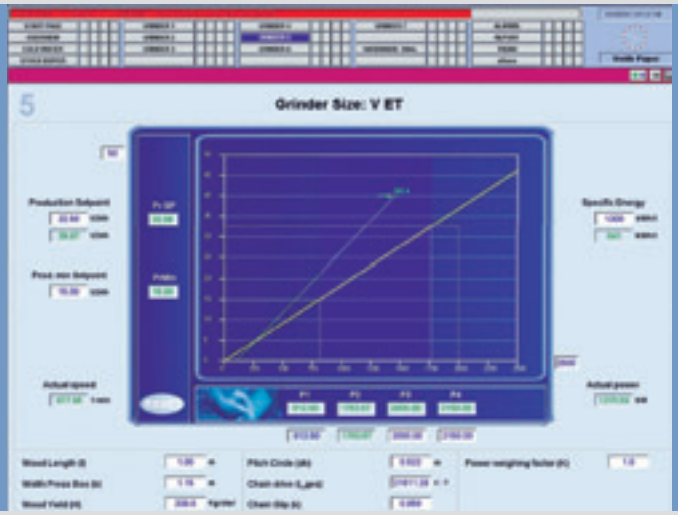
**Zone 3:** $P_{eff} > P_3$ (overload range)
If power consumption exceeds the upper limit $P_3$, constant energy control mode is replaced by dynamic power control. The special feature of this power control mode is a response function to prevent excessive log compression from the outset. This works by reducing the chain feed rate to comply with a given power consumption setpoint continuously computed from the equation:
$P_{calc} = P_{eff} - (P_{eff} - P_2) \bullet k$.

After exceeding $P_3$, the response function follows this continuous setpoint reduction until the power consumption has fallen to $P_2$ again or slightly below **(Fig. 5)**.

The biggest challenge for us was to implement this control system, because it meant exploiting the entire available know-how on continuous grinder operation. We received decisive support in this connection from Hans Henrich during the

**Fig. 5:** *Parameter display – grinder control.*

**Fig. 6:** *Documentation system with eDoxx browser.*

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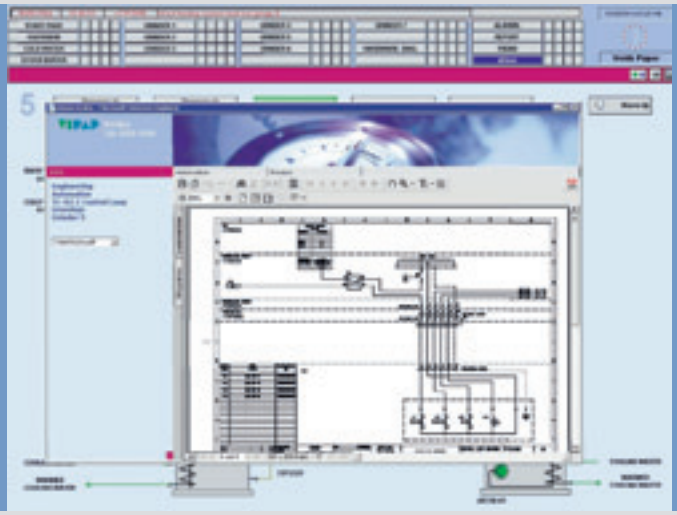

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course of numerous intensive discussions and interviews, right up to software testing and individual control program simulation. Thanks to this, the commissioning was smooth, troublefree and quickly completed. Now we can monitor the 7 grinders by remote control from Ravensburg, and make any necessary program changes or optimizations.

In addition to the automation, we installed a very useful maintenance documentation program known as “eDoxx”. This document browser developed by Voith is integrated in the control and visualization system.

The electronic plant documentation can be called up directly on the control screen. It contains the following :

- Maintenance and operating manuals with setting instructions for the machinery and Electrical and C&I units
- P&I diagrams, energy balances and consumer listings
- Logic diagrams, loops and listings for the C&I and process control systems
- Plant and operation descriptions.

This gives fast and easy access to the entire documentation for troubleshooting and training purposes (Fig. 6).

## Summary

Many well-known papermakers depend on groundwood as a raw material, because its high fines content enables good printing quality on SC and LWC grades. For this reason more and more groundwood producers are upgrading their machinery for higher performance and greater production capacity.

Compared with other control concepts, the revised TGW control offers some significant advantages:

- More stable operation than in constant power or constant feed control mode, thanks to constant specific energy consumption
- Longer grindstone life because less sharpening is required
- Consistently good grinding quality
- Better grinder control because deviations from operating setpoints are counteracted faster.

Apart from general refurbishing and automation of stone grinders, Voith Paper also offers a selection of second-hand grinders. For more information please visit www.voithpaper.com / e-business.