

IMPROVEMENT OF PERFORMANCE – REDUCTION OF OPERATING COSTS FOR BACK UP ROLL GRINDING IN CHOCKS¹

*Michael Utsch²
Peter Vinke³
Igor Oberding⁴*

Abstract

With the new lifting table design, Waldrich Siegen has developed a system to increase the availability and flexibility of grinding machines. The hourly rate cost calculation shows the high potential for return on investment within less than two years. Due to the high amount of automation, lifting tables are easy and safe to handle by the operational personnel in the roll shop.

Key words: Chocks; Grinding machines; Lifting tables.

Resumo

Com o projeto e desenvolvimento da nova mesa de elevação, a WALDRICH SIEGEN criou um sistema para aumentar a disponibilidade e a flexibilidade de retíficas de cilindros de laminação. O cálculo do custo por hora demonstra o alto potencial de retorno para o investimentos em menos de 2 anos. Devido ao seu alto grau de automação, mesas de elevação são de operação fácil e segura.

Palavras-chave: Mancais; Retíficas de cilindros; Mesas de elevação

¹ 43rd Rolling Seminar, Processes, Rolled and Coated Products, October, 25 to 28, 2005, Santos, SP, Brazil

² Production Engineer, Project Manager Marketing Roll Machining Equipment at Waldrich Siegen

³ Production Engineer, Project Manager Marketing Roll Machining Equipment at Waldrich Siegen

⁴ Mechanical Engineer, General Manager Brazil at Waldrich Siegen Rep. Office Latin America

INTRODUCTION

Centralizing back up roll grinding in chocks for hot and cold mill applications is the current task in the steel industry worldwide. Due to the high amount of different geometrical dimensions in back up roll chocks, set-up time in the grinding machine and preparation for loading and unloading increases. As a consequence the capacity of the grinding machine is reduced. In addition high labor costs and reduction in operational personnel make it necessary to find ways to reduce costs and time to come to a more efficient process.

New developments (e.g. lifting tables) provide higher machine availability, less operation personnel and operation benefits. In the following the lifting table system will be introduced and an hourly rate calculation will show cost savings and a quick return on investment.

BACK UP ROLL GRINDING IN CHOCKS – CONVENTIONAL GRINDING MACHINE DESIGN

Grinding in chocks has become the state of the art process for grinding back up rolls worldwide. Most new machines are provided with accessories to grind rolls in chocks. Main benefits are better roundness conditions, easy and safe roll handling, lower spare parts cost, lower bearing maintenance and higher flexibility.

The rolls with chocks on are placed and fixed on a traverse and grinding is done under the same conditions as in the mill (Figure 1). A separate Morigoil unit for oil supply of the bearings is usually needed.

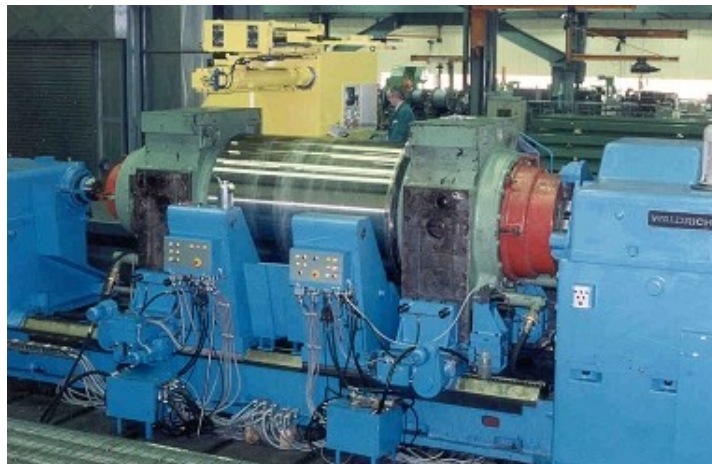


Figure 1. Example conventional grinding in chocks

A roll driver is mounted on the roll neck (sometimes a cardan shaft needs to be provided instead). Depending on the chock size and design different adapter plates need to be mounted between work piece bed and chock, to adjust the roll on centerline of the grinding machine. Each roll type usually needs its own set of adapter plates.

After grinding, no additional assembly work needs to be done and the back up roll is ready for production again.

NEW DEVELOPMENT – GRINDING MACHINE WITH LIFTING TABLE BY WALDRICH SIEGEN

During the last 2 years, WALDRICH SIEGEN has designed a new system to automate the set-up of different types of rolls with and without chocks. Goal was to reduce set-up time and find a flexible system to grind work pieces with different geometrical conditions.

The following Figure shows a principle sketch of the lifting table in two different positions.

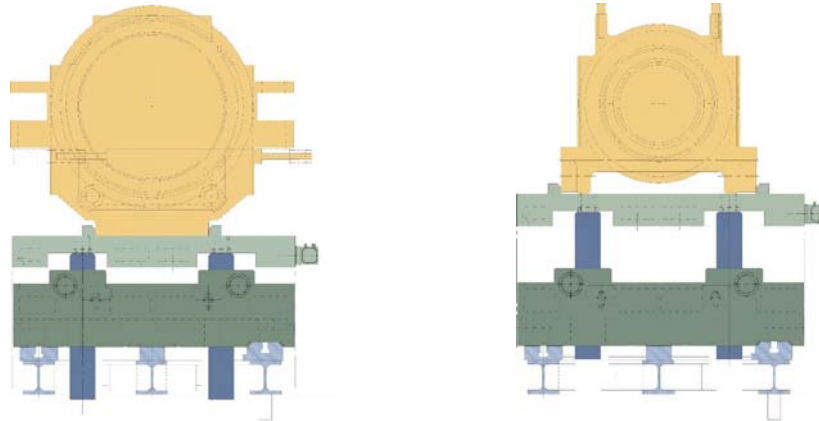


Figure 2. Principle sketch – table in different positions

The left sketch shows a chock placed on the lifting table in a lower position, the right sketch shows the situation for a smaller chock. Both roll centerlines are set-up to be identical with the machine centerline. But the lifting table is not only designed to accommodate different chocks, also hydrodynamic steady rests for grinding work rolls or hydrostatic steady rests for grinding back up rolls without chocks, can be placed on the table. WALDRICH SIEGEN has already provided several machines with this new system and machines are also running in production (Figure 3).



Figure 3. Lifting table installed on machine

On the left picture table is in upper position to support smaller chock for grinding back up rolls in chocks, right picture table with steady rest to grind work rolls on a machine used as kombi-machine.

All axes of the lifting table are provided with measuring devices and are linked to the CNC control. Various table positions for different rolls and chocks can be stored and selected for automatic approach at any time.

The lifting table design gives the opportunity to reduce the changing time from one work piece type to another and guarantees an easy and safe handling during loading and unloading for the machine operator.

MACHINE HOURLY RATE CALCULATION

As with any accessory on a grinding machine, additional costs are involved with additional equipment. In the following WALDRICH SIEGEN has calculated the costs and possible savings, based on a machine delivered to a customer in Europe.

First we need to calculate the machine hourly rate:

The machine hourly rate should include all direct and indirect costs, including costs for human resources. The equipment value is the complete costs of machine plus some accessories.

Basic Data:

A	Equipment value (including accessories etc.):	€ 3,150,000.-
a	Service life:	10 years
p	Interest rate:	8 %
d	Maintenance factor:	0.2 x depreciation
F	Space requirement:	112 m ² (200.- €/m ²)
Tf	Operation time of machine :	6570 hour/year (365*24*0,75)
W	Tooling requirement:	41,600 €
	Personnel:	1 person / shift
	Hourly wage:	25 €
	Indirect wage costs:	250 %
	Installed power:	325 kW
P	Average power consumption:	162,5 kW (50 %)
E	Energy factor:	0.05 € / kW

Calculation machine hourly rate:

1	Depreciation	= $A / (a * Tf)$	= $3,150,000 / (10 * 6,570)$
	= 47.95 €		
2	Interest	= $(A*p) / (2*100*Tf)$	= $(3,150,000*8) / (2*100*6,570)$
	= 19.18 €		
3	Maintenance	= $(A*d) / (a * Tf)$	= $(3,150,000*0,2) / (10*6,570)$
	= 9.59 €		
4	Floor space	= $(F*k) / Tf$	= $(112*200) / 6,570$
	= 3.41 €		
5	Energy costs	= $P*e$	= $162.5 * 0.05$
	= 8.13 €		
6	Tooling	= W / Tf	= $41,600 / 6,570$
	= 6.33 €		
7	Taxes and insurance	= $(A*s) / (Tf*1000)$	= $(3,150,000*6)/(6,570*1000)$
	= 2.88 €		
	Machine costs (line 1 – 7)		= 97.46 €
	Direct labor costs (operator)		= 25.00 €
	Indirect labor costs (overhead costs 250 %)		= 62.50 €
	<u>TOTAL</u>		<u>= 184.96 €</u>
	MACHINE HOURLY RATE		<u>185.00 € / HOUR</u>

Fifty per cent of the machine hourly costs are related to human resources, this also indicates that there is a high potential of automation benefits.

TIME AND COST SAVINGS

The next step is to calculate the time and cost savings by using the lifting table design from WALDRICH SIEGEN. Normally roll-changing time with conventional design includes the block changing and adjustment time plus time for crane handling. Together with the time needed for cleaning and storage of the equipment the average preparation time is approximately 45 minutes. With the new lifting table design this time is reduced to 15 minutes total.

Table 1. Cost savings with lifting table

Stand	Total preparation time [Min])*	Crane handling time for machine preparation [min])*	Preparation time [Min])**	Crane handling time for machine preparation [min])**	Time saving with lifting table [Min]	Savings per roll [€]	No. of rolls per year	Total savings per year (average) [€]
BUR CM II K1-K6	45	45	15	0	30	92.50	490	45,325
	45	45	15	0	30	92.50		
WR RS HM V4-V6	45	45	15	0	30	92.50	425	19,656
	15	15	15	0	0	0		
DUO'S HM V1-V3	45	45	15	0	30	92.50	235	21,738
	45	45	15	0	30	92.50		
BUR CM I S 1-3	45	45	15	0	30	92.50	150	13,875
	45	45	15	0	30	92.50		
BUR CM I S4	45	45	15	0	30	92.50	180	16,650
	45	45	15	0	30	92.50		
BUR CM I S5	45	45	15	0	30	92.50	180	16,650
	45	45	15	0	30	92.50		
BUR SP 48	45	45	15	0	30	92.50	36	3,330
	45	45	15	0	30	92.50		
BUR SP 12	45	45	15	0	30	92.50	50	4,625
	45	45	15	0	30	92.50		
BUR SP 11	45	45	15	0	30	92.50	66	6,105
	45	45	15	0	30	92.50		
BUR DSP	45	45	15	0	30	92.50	280	25,900
	45	45	15	0	30	92.50		
Total savings per year: (Total savings per year for grinding machine operation costs – excluding crane savings)								<u>157,204</u>

)* Conventional design

)** Lifting table design

The table shows an example with 10 different roll types. Each type of roll has top and bottom rolls. Total preparation time with conventional design is 45 minutes and with lifting table only 15 minutes. This time saving of 30 minutes gives you a saving per roll of € 92.50. Multiplying the cost savings per roll with number of rolls per year gives you the total savings. At the end the total savings add up to more than € 157,000.- without savings from the crane operation.

RETURN ON INVESTMENT (ROI)

This example from an existing roll shop shows that total savings of € 157,000.- per year are realistic. In comparison with the additional costs (approximately € 300,000.-) for the lifting tables the return on investment is less than 2 years. In addition one operator can do the machine set-up only and you are more independent from the overhead crane availability. No additional costs for adapter plates, handling and storage of the plates.