

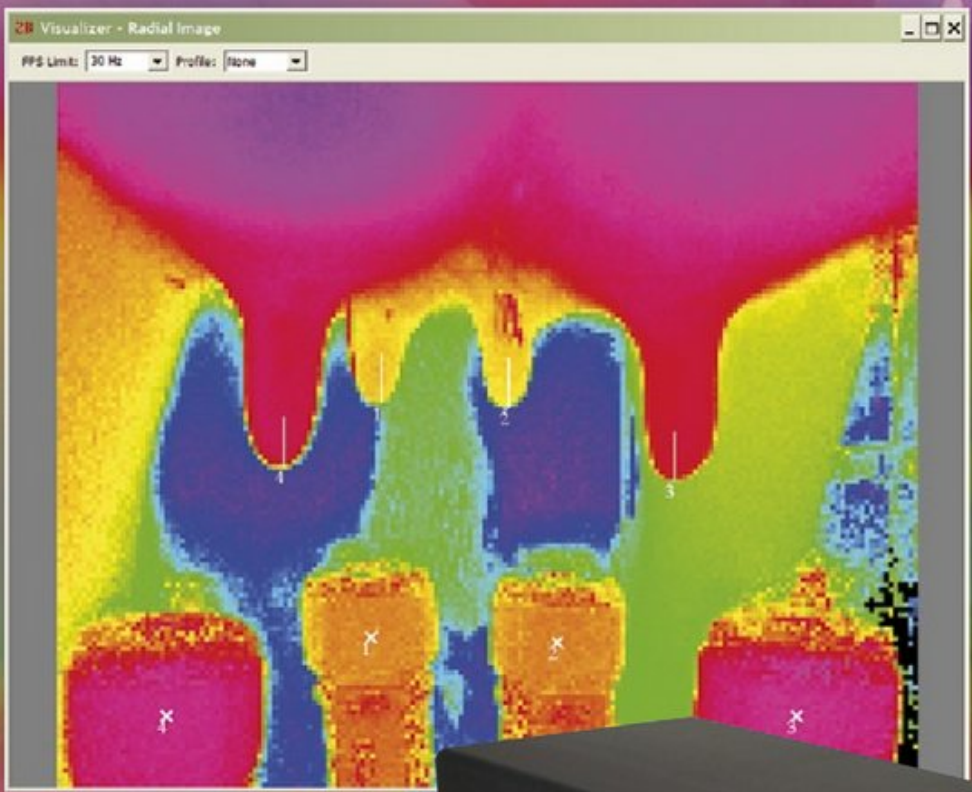
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Cost Optimization of Tube Manufacturing

Applying Cutting-edge Measurement Equipment to Improve Efficiency

“A penny saved is a penny earned” says a proverb. This is especially true when you are concerned with the success of your business. Therefore, reaching a high degree of efficiency is one of the main goals of a company. Manufacturing processes must be optimized continuously, and costs have to be reduced. However, where to start with cost savings? Businesses that produce tubes and pipes often mention four areas of costs that have a serious effect on total costs: gauge costs, material costs, storage costs and setup costs of bending machines.

Exemplary calculation of possible savings due to replacement of gauges:

Need of new gauges per year	5 pieces at € 2,000
Cost of maintenance and inspection	€ 500 per gauge p. a.
Potential savings in first year	€ 10,000
Potential savings in second year	€ 12,500
Potential savings in third year	€ 15,000

In order to minimize these costs, it pays off to invest in modern measuring technology today. Based on the experiences of many tube and pipe manufacturers, especially the application of optical, tube-dedicated measurement equipment gives a good return. The camera-based measuring system TubeInspect, developed by Aicon 3D Systems from Germany, has been designed in cooperation with users from the automotive industry and accounts for the requirements of both manufacturing and construction departments.

TubeInspect measures a tube's geometry with high-resolution digital cameras in only a few seconds. For this, the tube to be measured is placed in the measuring cell. An illuminated measuring plate in the cell ensures that all parts of the tube are ideally visible. The digital cameras are positioned above the

Ralf Unger, taking care of the quality assurance at König Metall GmbH & Co. KG in Gaggenau (Germany), appreciates the fast and effective process control with TubeInspect



► The optical measuring system TubeInspect replaces cost-intensive mechanical gauges



Since applying the optical measuring system, Serto AG in Switzerland has been able to reduce material costs significantly

measuring plate and acquire images of the tube from different directions. Evenly distributed reference points on the measuring plate guarantee for the correct spatial orientation of the cameras. Aicon defines their positions accurately to a hundredth millimeter during the installation of the system. The result display is easily understandable, also for users without technical background. Thus it allows for flawless evaluation of the measurement.

But how is TubeInspect able to reduce costs?

Elimination of Gauge Costs

Before a tube goes into series production, the prototype is changed many times with respect to its material and geometry until it will finally meet the requirements. Of course, also these prototypes have to come under scrutiny. This implies, when working with mechanical devices that an individual gauge has to be fabricated for each prototype. Depending on the tube, the costs for a gauge are between € 2,000 and € 4,000. Whenever a prototype is changed, the corresponding gauge has to be adapted, too. Including its final inspection by mea-

suring the geometry, this can take up to two weeks. Yet not only causes the gauge adaptation a high amount of costs; it also leads to long delivery times that are often unacceptable for the customer. When using TubeInspect, it is possible to completely renounce to manual gauges. The operator simply types the new data (X-, Y-, Z-coordinates of bending points) into the data base of the measuring system – and after only a few minutes the measurement of the changed prototype can begin. TubeInspect works as a virtual gauge for any type of tube, and it can be applied in series production, too.

The possible savings in series production can easily be clarified with the following example: Due to five new products per year, a production facility has a yearly need for five new gauges at the price of € 2,000 each. Their annual maintenance and periodic geometry check amount for approx. € 500 per gauge per annum. When applying a flexible measuring machine such as TubeInspect instead of gauges, savings of € 10,000 are generated within the first year because no new gauges have to be acquired. In the second year, the savings account for € 12,500 as both the

maintenance costs for the gauges of the previous year (five gauges for € 500) and the investment of € 10,000 in five additional gauges for new products are omitted. Accordingly, € 15,000 can be saved in the third year.

Reduction of Setup Times for Bending Machines

In production, a new setup of the bending machines is necessary e.g. whenever the product is changed. Very often, well-experienced staff members have to attend to the setup as it demands great skills. And even then it can take several hours in case of complex tubes. Meanwhile production stops. At this point, TubeInspect can bail you out: With the help of the measuring system, correctional data is generated within a few seconds and transferred to the bending machines. As a consequence, their setup will only last a few minutes. The attained savings can be clarified using the example of a typical tube manufacturing plant as it is common in the supplier industry:

The exemplary company disposes of a manufacturing capacity of four bending machines. Thanks to its flexible production strategy, it is in the

Intelligente OEM Kamera mit abgesetztem Sensor

Intelligent Components von VRmagic arbeiten autark mit eigenem Linux-Betriebssystem. Algorithmen werden über Cross-Compiler auf die Kamera übertragen.



- 300 MHz ARM9 Prozessor
- 600 MHz DSP, 4800 MIPS
- FPGA optional
- 128 MB RAM
- 512 MB Flash-Speicher
- Standard Debian Linux
- UBIFS Filesystem
- GCC Cross-Compiler
- Auflösungen von VGA bis Megapixel

- 100 Mbit Ethernet
- Trigger und Strobe
- USB Host und RS232
- General Purpose I/Os
- Analog-Video-Ausgang

Alle Komponenten von VRmagic werden über die gleiche API angesteuert.

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position to deliver products in small batches right away. Over a longer period, setup procedure and time were analyzed with and without using TubeInspect. During the observed period, every bending machine was changed over twice a day on average. With TubeInspect, the setup time could be reduced by 0.75 h. The cost of machine downtime is calculated with €100 per hour. This results in potential savings of € 120,000 in the first year under the assumption of 200 manufacturing days per annum.

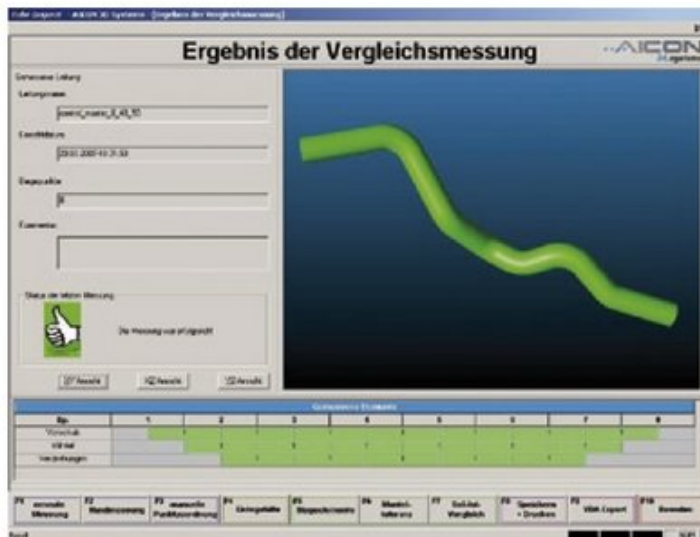
This observation is also affirmed by Ralf Unger, responsible for the quality assurance at König Metall GmbH & Co. KG in Gaggenau (Germany) who has applied TubeInspect since December 2006. "With TubeInspect we are in the position to monitor our processes in a fast and effective way as the measuring system shows accuracy information for the bent tubes after only a few seconds. Therefore, the approval for production can now be given in record time. In the past, when the measurement was tactile, we had to wait for the approval for a really long time. Moreover we have reduced the setup time of our bending machines considerably. The gained free machine capacities mean hard cash to us."

Reduction of Material Costs

Material prices increase steadily. Especially the high price for steel hits businesses where it hurts. Hence the reduction of reject parts gets more and more important. Thanks to the fast setup of the bending machines, TubeInspect also pays off in this issue. Joe Girtanner, Director of Production at the Swiss tube manufacturer Serto AG, reports about his experiences with TubeInspect: "The number of deficient tubes has been strikingly reduced. When a new production run starts,

Exemplary calculation for savings thanks to shorter setup times of the bending machines:

Number of bending machines (BM)	4 pieces
Number of changeovers per day per BM	2
Time savings per change over	0.75 h
Costs of machine downtime per hour	€ 100
Number of work days per year	200
Savings p. a.	
$E = 2 \text{ changeovers} \times 4 \text{ BM} \times 0.75 \text{ h} \times € 100 \times 200 \text{ work days}$	
	= € 120,000



Thanks to the clear display of the measuring result, the quality can be evaluated immediately

the second tube meets the requirements. And as we mainly manufacture tubes made of expensive materials, we clearly notice the strong decrease of costs in this area." Serto employs the material 1.45.71 for example (rust-acid-resistant, titanium-stabilized stainless-steel) in order to manufacture tubes for coffee machines. This material has, just as the whole stainless-steel market, experienced significant price increases in the last years. Due to the optimized material consumption, Serto can partially absorb the increased costs now.

Storage Costs

Particularly companies with a high percentage of in-house-manufactured components and with many active products have a huge need for

tion "master measurement" and measure the tube in two different positions. Thus TubeInspect can automatically generate the bending data. These data are then saved as nominal geometries in TubeInspect's data base.

What are the advantages of the master measurement? Joe Girtanner explains: "In the past we had to store samples of every manufactured tube, no matter if the batch size comprised 20 or 10,000 pieces. This was necessary to handle follow-up orders rapidly. Today we are in the position to send back the sample tubes to our customers as soon as the data are digitally saved. As a consequence, we have been able to reduce the storage capacity tremendously."

Upshot

Especially in view of the current economic situation and the increasing pressure of competition, it is worth to work hard on cost reduction. For a flexible measuring device such as TubeInspect, it is easy to calculate the return on investment. Many users realize after this calculation that an investment in optical measuring technology will amortize after only one year – and nothing is more convincing than bare figures.

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