sitola GmbH & Co. KG

cut technologies

Sales department

Possibilities and advantages of *Retrofit*

Referee: Rüdiger Simon

Author: Rüdiger Simon, Christian Tiede

sitola GmbH & Co. KG

Obere Hommeswiese 23-25

57258 Freudenberg

Germany

Telefon: +49 2734 4361 10

Fax.: +49 2734 4391 15

E-Mail: info@sitola.de

Web: www.sitola.de

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Table of contents

Table of figures

1 Introduction

In the following the subject *Retrofit* shall be presented in detail because it has become an interesting option for manufacturing and processing companies. More and more companies have made use of this option lately. It offers numerous advantages in the area of cost-saving as well as in maintaining a high quality.

By the term *Retrofit* we generally understand the cost-effective modernisation of used production plants. This can be realized by replacing the mechanical components as well as by modernising the electrical components, especially the machine control.

In this presentation we focus on the processing machines in the foam manufacturing and processing industry. These are special cutting machines by means of which for example foam blocks are cut into the desired shape.

First of all, current company external and internal challenges and developments are presented which let *Retrofit* become an interesting subject for the companies.

Finally, the possibilities and advantages shall be analyzed which *Retrofit* offers for the companies described. First of all the different possibilities and scopes of design for three groups of cutting machines are described. Building up on that, the advantages as far as quality and cost saving are enumerated.

2 Current Challenges

The foam manufacturing and processing companies are facing challenges at present which they have to react to individually. First of all, slowly changing market conditions can be named here as far as sales turnover and also costs are concerned. Internal challenges occur among others in the production, especially as far as the machine equipment is concerned.

If you have a look at the sales turnover of a company, you will recognise that the industrial sectors of the foam processors were able to maintain their sales growth in the first six months of 2008 compared to the year before, and were partly able to increase it.[1] This is partly the result of the still good order situation of the companies. Only the packaging industry made a loss at single digits compared to the first two quarters in 2007. If one, however, includes the general opinions of the companies in view of the overall economic development, one recognises a growing caution in many trades.

If you have a look at the costs of foam manufacturing and processing companies, the steadily rising prices of raw materials as well as the steadily rising labour costs are great challenges which move into the centre of attention.

The commodity prices for foam are steadily rising. The price for MDI e.g. went up to 2.00 EUR/kg lately whereas the price for TDI settled at only just under 3.00 EUR/kg.[2]

[1] cf. Statistisches Bundesamt Deutschland: Beschäftigung u. Umsatz d. Betriebe des Verarbeitenden Gewerbes. Fachserie 4 Reihe 4.1.1. January 2007 - June 2008 <https://www-ec.destatis.de/csp/shop/sfg/bpm.html.cms.cBroker.cls?cmspath=struktur,sfgsuchergebnis.csp> (28.08.2008).

[2] cf. (without author): Polyurethane Raw Materials Price Chart, in: Urethanes Technology International. London (Crain Communications Ltd.) August/September 2008, p. 52 (29.08.2008).

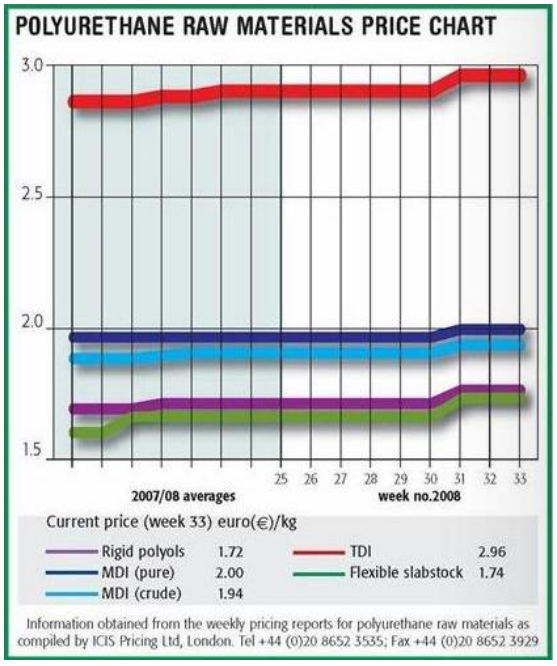

Figure 1: Polyurethane Raw Materials Price Chart

Source: Urethanes Technology International. London.

Because of the fact that the commodity prices depend on the increasing demand and also on the crude oil price, one can assume that instead of a slight relaxation in the third quarter of 2008 the costs will further increase in the long run, and thus one can assume that all commodity prices for foam will increase, too.

The rising labour costs also present a great challenge for the companies in the foam industry. The labour costs in the private industry e.g. increased by 1.6% in the first quarter of 2008 compared to the previous year.[3] If one takes the current inflationary development into consideration, further increases in labour costs can be assumed.

Because of the above mentioned company external challenges the involved companies face, one can assume that cost saving measures will be taken in order to guarantee competitiveness in the long run.

The foam manufacturing and processing companies also face internal challenges as far as the production is concerned. Here the focus is on aging machines. Many of them are not used because they do not meet the technical requirements any more and can thus not be integrated into the current production.

[3] cf. Statistisches Bundesamt Deutschland: Arbeitskostenindex <http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Statistiken/VerdiensteArbeitskosten/Arbeitskosten/AktuellArbeitskostenindex,templateId=renderPrint.psml> (29.08.2008).

It strikes the eye that many control cabinets of machines in use are left open and unlocked. The cables of the components are exposed and thus rotten over the years. Therefore it is not surprising that apart from common wear and tear additional unexpected machine failures occur which interrupt the operation.

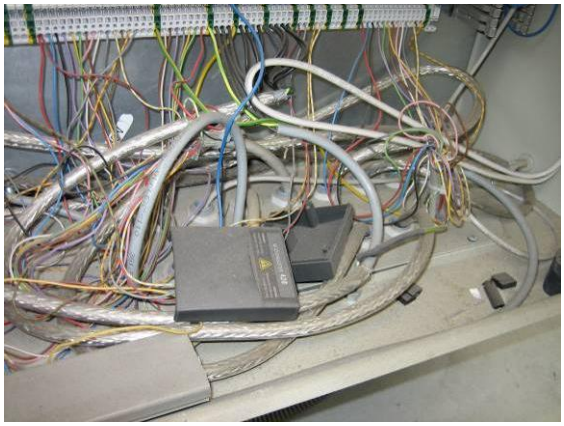

Figure 2: Control unit of a foam cutting machine

Source: Taken by author.

The further production planning becomes complicated because in the case of old machines the spare parts supply especially concerning the controls proves to be difficult. Many components are not manufactured anymore and to repair them requires a great effort and it is cost-intensive. It often cannot be precisely predicted when exactly the machine can go into operation again and this often results in long machine downtimes.

In order to prevent these partly controllable risks, many companies face the decision to replace their old machines by cost-intensive new ones in order to keep the production process running efficiently.

3 Possibilities and advantages of *Retrofit*

3.1 Possibilities of Retrofit

Since the solid mechanics of cutting machines is very often spared the ravages of time, only the affected wear parts are replaced and overhauled as there are e.g. the running wheels and the knife guides especially the CNC knife turning unit.

If the electronics of the machine cannot be used anymore or if the maintenance is not worth the effort, it is advisable to replace the out-of-date drive technology.

In foam processing it is vertical cutting machines, horizontal cutting machines and CNC cutting machines that profit from *Retrofit* measures. The life expectancy of these machines becomes decades long.

Retrofit includes the complete planning and realization of the modernisation from the review of the situation to the new start-up and the training of the operating personnel.

3.1.1 Vertical cutting machines

These machines are part of the basic equipment of machinery of foam processing companies. Vertical cutting machines generally consist of two stationary tables in the centre of which the smooth or toothed band knife or band saw runs vertically. The technical equipment of a machine depends on its range of application.

Figure 3: Vertical cutting machine

Source: Taken by author.

The machines are used for the further processing of e.g. polyurethane blocks (block edging) or for manufacturing rectangular cuttings from stacked foam plates.

Vertical cutting machines which have got long in the tooth and whose mechanics are worn out and whose control and drive technology are out-dated are very trouble-prone. It is hardly possible to carry out precise foam cuts. The downtimes increase and

thus jeopardise the operational availability of the cutting machine.

The drive configuration of these machines is often based on a D.C. drive for the travelling cutting unit and a pole changing A.C. motor or D.C. motor for the motor adjustable side stops. Repairing such out-dated drive technology today requires a great effort and can only be carried out at high cost. Even the electronic preset counters for cutting thickness and number of pieces approach their expected end of their life cycle for electronic components. An increase of repairs can thus not be excluded.

The replacement of mechanical components and the application of up-to-date control and drive technology offer a cost-effective solution to this problem. The cutting machine thus reaches the state-of-the-art.

A compact control cabinet with integrated control panel and a SPS-control replaces the out-of-date control and the preset counters of the cutting machine. Existing plug connectors to the control cabinet can often be used and thus reduce the installation time.

The travelling cutting unit is supplied with a new frequency controlled A.C. motor. If necessary, the drives of the side stops can also be replaced by frequency controlled A.C. motors.

3.1.2 Horizontal cutting machines

In the case of horizontal cutting machines one distinguishes among others between stacking machines for cutting polyurethane soft foam blocks and splitting machines for splitting e.g. polyethylene PE, rubber, EVA or hard foam.

Figure 4: Horizontal stacking machine

Source: Taken by author.

Horizontal stacking machines are able to cut a complete polyurethane soft foam block into any thick or thin plate. Because of the so called stacking cut the single plates do not have to be taken off.

Horizontal stacking machines are provided with a more solid construction, and split soft as well as very hard materials into single plates of different thicknesses. In the majority of cases, the split plates have to be taken out of the machine manually one by one. Depending on the tasks and requirements, the technical equipment of the machine may vary.

As already mentioned when describing the vertical cutting machines, the out-of-date control and drive technology jeopardises a smooth and safe production process. This also applies to the horizontal cutting machines.

In this case a *Retrofit measure* also presents an economic and cost-saving alternative compared to the purchase of a new machine. Depending on the machine type and the design, not only the faulty mechanical components are replaced but also the old and faulty D.C. Motors are replaced by modern frequency controlled A.C. Motors. An essential part of the new machine control is the SPS-control with control panel. It replaces the faulty and out-of-date

Figure 5: Old machine control of a horizontal splitting machine

Source: Taken by author.

preset counters for cutting thickness and number of pieces. All necessary machine functions can thus be operated fast and easily.

3.1.3 CNC Contour cutting machines

Contour cutting machines make cuts of any geometrical shape from different materials possible. One distinguishes between machines using band knives as cutting tools and machines using cutting wires as cutting tools. CNC contour cutting machines are used in the upholstery industry, furniture industry, mattress industry, automotive industry as well as by manufacturers of insulating materials.

Figure 6: CNC contour cutting machine

Source: Taken by author.

There are vertical and horizontal CNC contour cutting machines. Depending on the machine type and the material to be cut, a toothed, oscillating knife or a toothed or smooth rotating knife is used. In this connection one speaks of a 3-axes CNC contour cutting machine. Materials to be cut are e.g. blocks made of polyurethane soft foam, rebond foam, polyethylene PE or Basotect melamine foam.

Hard and very hard materials like e.g. blocks of rebond foam and polyethylene with a very high density, mineral wool, glass wool, foam glass or corrugated board can also be cut with CNC contour cutting machines. For this application a 2-axes-CNC contour cutting machine is used with a rotating cutting wire with all round cutting efficiency.

The old drive technology of CNC contour cutting machines is based on D.C. motors and appropriate CNC controls. Some of the old CNC controls only possess one single digital display for displaying the individual program steps of a cutting program. There is no supporting graphic display for the cutting programs. The storage medium for cutting programs is e.g. a mini-tape recorder system or a disc drive. This kind of technology does not meet today's requirements. The out-of-date Logik-components are very trouble-prone and can in most cases only be repaired by the manufacturer.

Figure 7: Old machine control of a CNC contour cutting machine

Source: Taken by author.

As a *Retrofit measure* up-to-date servomotors and automation components are applied. A simple replacement of the control ensures a fast and high operational availability.

The old servomotors (CNC-axes) are replaced by new motors including the connection cable and corresponding adapter plates.

3.2 Advantages of Retrofit

3.2.1 Advantages through improvement of quality

Talking about the advantages resulting from Retrofit it is first and foremost the machine related optimizations which result from a more reliable and easier operation of the machine that have to be mentioned here. As a result additional improvements of the products are achieved.

Figure 8: Replacement motor for cutting machine

Source: Taken by author.

Out of date and trouble-prone components are replaced by new and reliable components which does not only lead to cost benefits but generally to a more reliable operation of the complete machine.

As a further advantage it can be stated that you are manufacturer independent and independent of the technical machine equipment. This results in a further standardization of individual components and thus these components are constantly available. Necessary repairs can be carried out faster and more easily.

Furthermore the particular electric hardware components as e.g. in the special case of the CNC cutting machine the IPC, the control panel, the servo-controls and servo motors are independent of the machine software and can also be easily replaced. Thus, the *Retrofit-package* is independent of particular system suppliers and guarantees at one and the same time the constant availability of individual components.

The replacement of the control results in improvements because of the clearly arranged and user-friendly design of the control panels. It is thus possible to fast and easily use the different machine functions.

Figure 9: New control unit of the vertical cutting machine

Source: Taken by author.

As far as the horizontal cutting machines are concerned one advantage results from the fact that the console is installed directly at the machine or in the control cabinet, so that all machine functions can easily be operated and monitored.

The controls for the CNC cutting machines impress with their simple and user-friendly design. The operating levels allow an additional manual operation besides the automatic operation and can be operated fast and easily without much training. The manufacturer independent compatibility of the programming codes of the major machine manufacturers is a great advantage. All cutting programs can be memorised, edited and graphically illustrated. The memorising process itself is easily carried out via a USB-interface or an additional network connection.

Figure 10: New control unit of the CNC cutting machine

Source: Taken by author.

Finally, the drastic improvements for the manufactured product shall be emphasized here. This applies among others to the CNC cutting machines. Since the variable knife speed or cutting wire speed the cutting behaviour as to different foam qualities is optimized because the band knife or the cutting wire can be brought into an optimal rotational speed and cutting quality ratio.

3.2.2 Advantages through cost savings

Since the new acquisition of a cutting machine is highly cost-intensive, *Retrofit-measures* for out-of-date and faulty machines are highly profitable because the costs for a second lifetime of a cutting machine amount to only a fraction of the prime costs

for a new machine. This especially applies to the CNC contour cutting machines whose prime costs are very high.

Furthermore the reduction of maintenance costs has to be mentioned here because the machine becomes more reliable.

Because of a more reliable machine, downtimes and possible production stops are prevented and the costs are further optimized. No more long waiting times resulting from the repair of machine components. All this results in a higher productivity of the cutting machine.

Another positive effect is the higher computing power which results in faster processing cycles. The improved ease of use reduces wrong inputs at the control panel of the machine, and also training times for personnel.

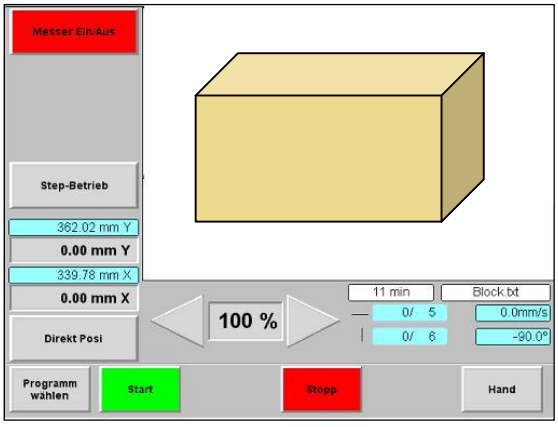

Figure 11: Program surface of the new CNC control unit

Source: Taken by author.

The cutting tools also profit from the mechanical overhaul of the machine because they now possess a longer life and thus do not only improve the quality of the cut product but also help reduce the total operating costs.

The management of cutting programs becomes safer and more reliable for CNC machines in particular. The often very high costs for the repair of the Logik-components cease to exist because of the application of current IPC technology.

4 Summary

In times of constantly rising commodity prices and rising labour costs the subject *Retrofit* as described above has proved to be an interesting option for manufacturing and processing companies in the foam industry.

For the cutting machines described it offers numerous advantages as for example the considerable cost savings. They result from the second lifetime the machine is given because the costs for *Retrofit* amount only to a fraction of the costs for the acquisition of a new machine.

Further advantages result from the general quality improvement. Here, it is the machine related optimizations that have to be mentioned primarily which result from an easier and more reliable operation of the machine. The manufacturer independent technology and the increase of productivity have to be mentioned here as the most important advantages. Not to forget the additional improvements of the cut product.