Automated hide unloading and conveyor system at JBS Couros Itumbiara plant in Brazil

Development of tannery automation

Karl Flowers, ILM Consultant Technical Editor, looks at the increasing need for greater automation inside the tannery and if there will be a time when robots and machines will be covering many of the traditional leather making functions carried out by humans.

In an industry that is very dependent on skilled and unskilled labour, the conversation about automation depends on where in the world the discussion is taking place. If the labour in question is unskilled labour, the argument will be about "how robots are replacing workers". Some politicians have even gone as far as saying that there should be a robot tax, which levies a company a form of income tax for each robot they use; the intention being to help pay for the worker layoffs "displaced" by these robots. The question companies should be asking is; if such a tax was ever to go through, can they claim unemployment insurance if their robot is idle?

Nevertheless, automation is a way of life for humans. Below is a list of low-skilled labour (and the machine) that has resulted in the usurping of humans by a machine that can automate their work:

- Washer woman (who cleaned clothes at the riverside) – washing machine
- Dishwasher – dishwashing machine
- Switchboard operator – PBX exchange
- Shop teller – self-checkout scanner
- Pump attendant – self-pump
- Hand flesher – fleshing machine
- Hand shaving – shaving machine
- Typing pool – personal computing

All these jobs are generally low-skilled and low paid, and they were made redundant not because people set out to deliberately make people unemployed, but they were targeted because they were labour roles that could be automated, and automation would allow an increase in the profitability of the company. The human jobs added a small amount of value to the product being produced but cost the company a wage that then needed to be paid. Economists would argue that the human cost, in many cases, added more to the costs than they did to the revenue. When an economic decision like this is considered, most business people would look to strip out the cost and automate where possible. If the human resource can then be redeployed in another part of the company and can add value there, then, the automation is a massive win for the company and the workers.

An example of this is the redeployment of shop tellers in large supermarkets from the front-of-shop to the picking line for online shopping in the warehouse. The overall number of staff in the supermarket did not change, but where this low-skilled labour was used, it did. The overall profitability of the corporate increased as automation, after the capital required to pay for this automation was deducted, occurred.

New jobs

Trade unions do have a strong case when the redeployment is not made and the excess of staff are shed. However, what is very much under-reported is the new jobs (in the last 5-20 years) that are by created by companies, jobs that were simply not in existence many years ago. These jobs continue to fuel the growth in the labour market, such as

- Social media manager
- Compliance officer
- Self-checkout engineer
- Shaving machine re-blading specialists
- Dishwasher and washing machine factory workers
- Online shop pickers and delivery workers

In other words, the newly designed jobs generally require a labour force to upskill or to redeploy into another industry. In high or middle-income countries, unemployment levels have been in steady decline due to economic growth and ageing populations, despite net immigration increases and increasing automation. The decline is helped by governments that look to shedding low-skilled work that do very little to contribute to the gross domestic product of the nation. Job creation in low or some middle-income countries focusses on finding cash (a cost to a company) to provide token employment for people, just for the sake of creating a low paid job. The reason companies are reluctant to do this is because the net gain for them is minimal, or the opposite. Some economists would argue, after you factor in the full economic cost, the low paid job creation drains a company of resource. Large work forces need human resource management and, as the number of workers increase, the efficiency of the company decreases.

Change management in large companies is more expensive and more difficult to achieve due to the complexities of human nature. A start-up business can change direction in a fraction of the time compared to that of a large company. In a very fluid leather industry at the moment, this is a huge strategic decision going forward.

History of automation in the tannery

From the Victorian period and the first global Industrial Revolution, the tanneries were required to increase the output of their production systems. Particularly placing footwear onto the feet of soldiers involved in conflicts that seemed to dominate the 20th century. Tanneries moved from slow, traditional recipes, to systems that required lower cycle times and faster machining.

The penetration of chemicals in and the extraction of unwanted substances out of the leather in the tannery has progressively moved from the use of pits, into steam powered drums, and onto modern electric powered systems. These wooden vessels were driven by leather belts attached to overhead pulleys and drive shafts. The workers who were required to stir and process the leather moved onto chemical operations, where they were needed to load and unload the drums. Alternative vessels, such as paddles and processors, did the same job but focussed on mechanical action and liquor concentration variations. The movement from steam-driven power to electrical power that turned motors, gearboxes and ring gears, allowed larger loads and variable drumming speeds. Recent developments in the internal furniture of the drums have even allowed slower speed and the consequent savings in energy. Plastic has allowed faster cleaning and less water.

The use of programmable logic controllers (PLC) has even allowed the drum operators to handle more than one drum and the increased use of complex run/stop patterns with timing and control. Braking systems for the drum and automatic drum door functions have meant faster additions or quality checks. Automated drain valves, load cells (that weigh the contents of the drum), and automatic drum dosing have allowed even further, faster and more accurate additions of chemicals or drum operation tasks that have lower error rates.

The downside to these automations is the increased level of expertise that is required by the mechanical workers who need to be able to fix quite complicated breakdowns. Some automations

Figure 1. Novel mechanical textures or cuts on leather.

systems can only be corrected by technicians, highly trained and normally only available through the machinery companies. A further difficulty is evident in the differing skillsets between the drum operator and the mechanic – somebody who can set the machine to do the work that is right for the leather. An operator is too under-skilled to identify detrimental or beneficial elements for the quality of the leather. Even the drum programmer, who can enter the recipe or the sequence of events that a drum must execute to ensure that the leather is made successfully, is often missing. Software companies can help and they can now provide solutions to tasks that were not available 20 years ago.

Raw materials handling

Hide and skin handling is another major area of development over the past 30 years. Hides are large materials that can fatigue, or simply challenge a tannery worker in their day-to-day handling. Some human bodies would not be able to lift a 60kg limed hide. Siding the hide or two-worker manipulations were obvious solutions in moving these cumbersome materials. To facilitate better, less fatiguing handling, overhead solutions or conveyor belt assemblies were born. These rapid transfer systems allowed less contact with the ground; a potential source of scratch or contamination damage. The use of gravity to hoist hides up and then let the potential energy of gravity do the work as the hide exits machines onto the inspection or trimming tables.

Rise of the machines

The tannery of old would have employed hundreds of people to do dehairing, fleshing, thinning operations, not to mention finishing and hand working operations. The beam was a common tool, the tannery and the bottleneck of many Victorian tannery was limited by how rapidly the manager could get many hides through these very strenuous, time consuming operations. The use of machines with spinning blades has allowed a large tannery to process quite literally thousands of hides through one or two machines. These machines can be the through-feed variety that allows one or two operators to insert the hide into the machine and then forget about it. Some would argue that these through-feed machines do not allow a good quality. Machine manufacturers just require better feedback if these quality issues are to be resolved using technology.

Machine automation often results in the hides or skins incurring some damage - the technical details of such will not be described in much detail in this article. The frequency of defects today is no higher than the number of defects seen due to hand working of the past. In fact, the frequency of limeblast is down compared to factories that used to hand flesh. Machines have also resulted in a

Figure 2. The use of exoskeletons in other industries.

much more consistent product being made as the settings of the machine govern work quality, not the energy levels of the worker.

There have also been some technological breakthroughs that have allowed leather effects that would simply not been possible with a human operator. Perforation, embossing textures, cutting, or buffing effects are just not possible with human operators.

Measuring the area of leather continues to receive the attention of the machinery companies. Area estimation techniques have been replaced with the pinwheel machine in the early 1900s and these great inventions are still the machine of choice when it comes to area arbitration. Electronic light sensor measuring machines or the use of video capture continues to see use and growth.

Even the automation of the effluent treatment plant has received automation help. Screening, settling, filtration, flotation, aeration are automated functions that would require tens of workers that would spend hours doing what a machine can do without any fuss.

Future automation opportunities

The handling of the hides and skins is a major area of focus for tanneries going forward. The ever increasing use of feeding and stacking systems on the front or rear of a machine is a growing trend in more automated plants. Conveyor chains get progressively longer as tanneries look to improve efficiencies and throughput. Many of these conveyors are cause for concern, as the leather is very prone to folding or twisting; if the conveyor is feeding a roller machine, then, these folds are often made permanent. Trials are underway in other heavy-lifting industries like the construction industry, where the use of exoskeletons help with the heavy lifting of objects.

Humans who are lifting large objects use a lot of energy. They are prone to back injury and fatigue throughout the day or week, resulting in peaks and troughs of efficiency and throughput. The use of an exoskeleton will solve these problems in the tannery going forward.

The insertion of the hides or skins into machines is an area where significant health safeguarding is required. Feed assemblies or extraction assemblies on splitting machines, shaving, buffing, or rollercoaters will continue to receive attention. Of course, jamming will be an issue in the early development but, given time and resource, these problems will no longer be a cause of concern.

The use of ever increasing quality control in the beamhouse, tanyard, and wet end drums will continue. At the moment, the quality checks often mean the drum has to be stopped, something is checked and, then, the drum is run again. If the door takes a long time to open and close, the cycle times of the process are severely affected. While the cross-sections of the leather can never be fully automated, the monitoring of float characteristics can be measured. These characteristics are not easily metered as the contamination of probes that sample the drum liquor has always been the biggest problem. Self-cleaning, probe automation and replacement, and the development of non-fouling or non-contact methods, will be the future breakthroughs required.

Use of drones

Another handling system that is inevitable is the use of drones in the factory. The cleaning, the delivery of chemicals, and the surveillance of operations allow faster and more efficient use of tannery workforce. In a large tannery, where the distance to walk to see things or the time wasting due to human personnel searches, can be expedited through the use of surveillance drones. Cameras also do not pick up all security problems when placed in fixed locations.

Robot drones that can deliver materials have seen increased use in other industries. In particular, the postal and packaging and the logistics industry lead the way in inventory control or the delivery of object to discrete locations. In the tannery, forklift drivers move materials around the tannery to where they are required. They do so efficiently and rapidly, but they do not do it effectively and they are prone to human error. Accidents, driving judgements and the influence of fatigue are weaknesses in human forklifting. Drones that have forks that can move pallets in great number (even on dedicated routes away from humans) can mean that materials can be moved rapidly around the factory. Flying drones can also take samples to the laboratory or can deliver materials to technical or mechanical technicians who need supplies. Even horses can be moved around automatically and can be positioned in exact positions in the tannery. Sensors as part of Industry 4.0 can allow smart movement of materials and graphical trackers can help the location of materials be more efficient.

ROBOTIC SUITS

The final big opportunity for development in the tannery comes in areas where people currently think it is unfeasible to use automation. The interaction between the material in a big lump and the position the material needed on a horse is considered outside the realm of automation. Robotic arms can be used to pick up a hide, locate the opposite side of a hide/skin, and place that material on a specified location. Initial innovations will be un-optimised, but it will only be a matter of time before efficiencies are made.

The automation of vacuum drying sees great developments, but the future may even see the use of automation to do the toggling operation. Systems trialled in the 1970s met some success but technicians in those days did not have the computing, robotic, and knowledge that is present today.

In a nutshell, the use of automation is to allow a more consistent human-error free operational style. Human resources can then be moved into other areas of the business that will allow expansion into other areas or will increase profitability. The role of the machine is another tool to be used in making great leather.

Figure 3. The future of toggling – is it robotics?