

INTERVENTION AGAINST TRADITIONAL OHS RISKS; REDESIGN AND PROCESS MODIFICATION OF THE MANUFACTURING OF PLASTIC BAGS

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BACKGROUND

In March 2003, AFA Insurance, the Swedish workers' compensation insurance, together with representatives of the employer and union organisations of the printing industry, initiated a pilot study into the reported problems of monotonous lifting tasks in the production of plastic bags.

The management of the biggest plastic bag manufacturer had reported high levels of absence, due to musculo-skeletal problems among the operators. The Printing Industry Employer Organisation alerted the AFA Insurance Prevention Department and an industry-wide project was initiated.

The purpose of the pilot study was to identify the harmful tasks in the manufacturing process, to calculate the costs of these ergonomic problems to the company, to AFA and to society, and to suggest a realistic technical solution to the problem.

THE PLASTIC BAG INDUSTRY

The plastic bag industry in Sweden is small, some 20 companies, and each unit employs only between 5 and 50 people. There are three main product lines with some overlap: carry bags, plastic bags on rolls, and bags for automated packaging of produce (bread, diapers, paper, etc).

The technology to produce plastic bags is old; the converting equipment has changed very little in the last 30 years. While more complicated computers have replaced the old steering equipment and production speed has increased, the mechanical and hydraulic technology is virtually intact. Many of the old machines are still in operation and can be maintained and repaired by local staff.

The ergonomic problems reported are mainly related to the manufacturing of bags for automated packaging and, to some degree, the manufacturing of carry bags.

The process requires manual intervention at stops along the production line, where produce must be lifted, moved, pushed or pulled in order for the process to continue. It's the traditional human job of being the necessary complement to manufacturing machinery.

The development of printing techniques, graphics and the requirements of marketing, however, has made these companies survive in a high wage environment like Sweden.

THE PILOT STUDY

The pilot study was conducted by AFA's Prevention Department in cooperation with the department of Design, Work Environment, Safety & Health at the Royal Institute of Technology (KTH).

Absence due to injury for all companies in this industry is recorded in the AFA claims registers. All reported injuries for the years 1998-2003 were identified. The companies were contacted and personnel staff identified and confirmed cases of absence due to musculo-skeletal problems related to the manual handling tasks under investigation.

Injury costs

According to the pilot study, around 250 people in 17 companies are exposed to tasks with monotonous static loads and repeated lifting. The total cost of absence due to this exposure alone is estimated at € 550 000 per annum for the industry or € 2 500 per employee, where the companies cover 40%, AFA 5% and General Sickness Benefit Insurance 55%.

These costs reflect earnings related compensation, i.e. salary costs alone, and does not include medical treatment costs or costs related to future permanent impairment or early retirement.

WORK ENVIRONMENT TODAY

The process of making plastic bags has three parts: extrusion, printing and converting, which represent different forms of manual workload. It is mainly the converting process that creates harmful exposures through static and repetitive tasks, which lead to injury and absence from work.

In the converting process, rolls of plastic film are mounted and fed into the machine, mechanical and hydraulic machine movements (clipping, folding, punching, welding, feeding, stacking) are monitored, produced stacks of bags are fed out and manually checked, folded and manually packed in boxes. Boxes are closed, handled on pallets and transported to storage.

Converting machines, produced by one of two machine manufacturers worldwide, are fairly uniformly designed and have a long lifespan. In recent years, manufacturers have developed more advanced governing equipment and new software, which has increased the theoretical performance of the machine and facilitated a higher production tempo. The mechanical and hydraulic equipment, however, is basically the same as in 30-year-old machines, many of which are still in operation, maintained and repaired by local company technicians.

The potentially high production tempo (400 items per minute) in the new machines should be compared to a real production tempo of a maximum of around 300 items per minute, which is the realistic and normal tempo in which a machine can be continuously operated.

The manufacturing principle means that feeding, clipping, punching, welding and out feeding of bags is done horizontally. In view of the demands for precision and quality in the stacking and handling of bags - for further use in automated manufacturing or packaging processes at customer companies - the produce must be lifted, inspected, folded and manually corrected by the operator during the out feeding from the converting machine.

Boxes and packaging material used varies considerably. Operators are packing by hand, often into boxes, which are not adjusted to the size of the produce to be packed, and the manual handling of stacks of bags, boxes, tables and pallets also varies a lot between companies.

In view of the longevity of machinery, the development of increasingly sophisticated printing methods and graphics, the dynamic links between the packaging, marketing and advertising and the competitive conditions inside and outside the country, there is a certain, if limited, potential for investment into and development of these processes. The trials involving industrial robots and automated handling of parts of the out feeding process, picking and packaging in certain companies do not represent finalised and functional solutions to the problems in these tasks.



ERGONOMIC ANALYSIS

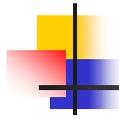
The operator's task around the converting machine could be said to represent residual work, not integrated into the mechanical and/or hydraulic operations of the manufacturing process.

The stacking of the bags is done with the help of metal clips or plastic buttons, which have to be placed in the feed-out line by the operator. When the correct number of bags have been fed out and stacked onto the clip or buttons, the operator must fasten the clip/buttons, put his/her hand behind the bags, grab the stack by the clip/buttons, lift it off and put onto a separate inspection board or work table.

The workload on hand, wrist, underarm and shoulders vary depending on the feed out mechanism. But there are obvious problems related to the manual application of plastic buttons, which the operator has to push and snap into place to lock the stack. This work task, which requires exercising muscular pressure above breast level, can cause injuries to the hand, and implies very high loads on hand, wrist, underarm, upper arm, shoulder and neck. This task should be eliminated.

The demands for quality control of the packaged stack of bags are reasonably high in the production of bags, which are to be delivered to customers who use them for direct feeding of produce in automated packing lines. The customer's line is disturbed if the delivered stack contains defective bags or bags with folded corners.

Inspection is done while the stack of bags is hanging in the feed out line as well as after it has been lifted off the line and put on the inspection board or the worktable. The table is often height adjustable, which will reduce the risk of harmful lifting - if the operator has adjusted the table at the start of the shift. The manual handling here must be considered light; potentially the work surface should be angled towards the operator in order to get a more suitable posture of shoulders, upper and lower arms.



Worksites often have design weaknesses, which might contribute to improper work postures. In certain manual tasks, operators handle produce and packaging material too far away from the body and with twisted torso; in handling details of boxes there are unnecessary loads due to incorrect placing of storage of produce. The storage surface is often a scissor table with a pallet, where the operator places the packed box. The full boxes are often too heavy to handle manually.

To a certain extent this can be remedied by a reallocation of work- and storage surfaces, which also will improve the flow of the work process, create better access and reduce the number of manual lifts. This must be thoroughly analysed with the help of involved operators and the technical company health care services.

In some short cycle production processes, converting and feed out will be directly onto a worktable where bags are stacked, inspected, lifted and packed manually. This is done in short series of special products with fast a turnover. The simplicity of this particular production design contains no specific ergonomic risk, mostly because of the short and varied exposure.

INCENTIVES FOR DEVELOPMENT

The majority of companies in the industry have shown a positive interest in the development project. There are three obvious economic motives for changing the manufacturing process:

- Company costs, including loss of production, for absence due to the harmful exposure of the process,
- Recruitment, since some companies have problems finding staff and where a more attractive work environment would secure future recruitment and make it possible to keep present staff,
- Improved productivity, since technological development has made machines faster than operators can work, and improvements to the ergonomic interface would utilize capacity better.

The New Work Station

Handling of clips and buttons - stacking

The development of the new design of the feed out and quality control workstation started in 2003. A prototype workstation, in a realistic industrial environment, was set up at a small plastic bag factory south of Stockholm. New and integrated solutions are developed for the work tasks, which handle out feeding, quality control and packing of bags from the converting machine.

A new piece of mechanical and hydraulic equipment, which automatically stacks and feeds out the bags, is developed. The operator's workstation is designed for ergonomically acceptable inspection and quality control and is equipped with mechanical lifting and handling aids.

Flooring, working heights, lighting, storage surfaces, packing equipment and other necessary equipment is defined, configured and tested. This means that the practical solutions for the general ergonomic and manual handling problems of the industry are presented in the project.

The project will result in a complete technical and ergonomically specified work station for operators at converting machines, where a prototype for the automated feed out equipment is built and tested. The project will be reported continuously and in detail to all companies and interests in the plastic bag industry.

The building, where the prototype workstation has been set up, serves as a meeting spot for the steering committee of the project and for all companies in the industry, who have been invited to inspect, discuss and critically contribute to the development of the new equipment. The obvious purpose of this is to deliver, at cost, a piece of automated feed out equipment to each of the company in the industry that need one.

The price of the new equipment will be low, to fit the perceived level of affordability for a small plastic bag manufacturer. This is made possible by the bi-partite project funding, covering the major part of the development costs.

STUDENT THESIS

Part of the development work was completed with the help of engineering students from KTH School of Technology and Health (Innovation & Design), who undertook their thesis work in cooperation with the project. They addressed work environment and ergonomic problems to be solved in the project, and their solutions are relevant to all companies in the industry.

CONCLUSIONS

Well-known occupational risks, closely related to work-related injury and disease associated with traditional and ergonomically archaic process manufacturing jobs can be addressed by the combination of

- Precise, detailed and correct injury information,
- Joint employer – union cooperation in problem-solving,
- Workers' compensation insurance, cost-efficient based funding of prevention initiatives,
- Cross-industry cooperation between companies,
- Simple, low-cost mechanical engineering,
- Practical teaching of engineering students in OSH problem solving

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