Ergonomics Best Practices for the Plastics Industry

The United States plastics industry annually ships $304 billion in product, maintains an annual trade surplus of $5.2 billion, possesses 23,000 facilities and has a presence in every state.

Ohio has 1,548 plastics facilities, the second most of any state. Ohio is second only to California in terms of plastics industry employment, and has the fourth-largest ratio of plastics industry employees in proportion to other manufacturing industries.

Accidents in the plastics industry remain above the average for all U.S. manufacturing, according to federal Bureau of Labor Statistics (BLS) data.

Many injuries in the plastics sector are musculoskeletal disorders caused by cumulative trauma. We call these injuries cumulative trauma disorders (CTDs). Back injuries, tendonitis and carpal tunnel syndrome are examples of common CTDs. Workplace risk factors for CTDs include repetitive motions, high forces, awkward postures and vibration exposure. CTDs in the plastics industry can be associated with such activities as manual material handling, removing parts from machines, and packing and trimming flashing from parts.

The ergonomics process

One effective way to reduce the risk of CTDs is to establish a process for managing ergonomics concerns in your workplace. Do not regard ergonomics processes as separate from those intended to address other workplace hazards. Use the same approaches to address erognomic safety problems, such as hazard identification, case documentation, assessment of control options and health-care management techniques that you employ to address other workplace safety problems. It is important to realize that you cannot combat effectively cumulative disorders with a quick-fix program. Rather, a long-term process, which relies on continuous improvement, is the preferred approach to reducing CTDs. Successful programs not only result in reduction of injuries, but they also realize quality and productivity gains.

For an ergonomics process to be successful, it is imperative that management is committed to the process, participates in the process and provides the necessary resources to ensure its success.

Include the following elements as part of effective management commitment:

1. Issue policy statements that;

- Treat ergonomic efforts as furthering the organization's goal of maintaining and preserving a safe and healthy work environment for all employees;
- Expect full cooperation of the total work force in working together toward realizing ergonomic improvements;
- Assign lead roles to designated persons who are known to make things happen;
- Give ergonomic efforts priority with other cost reduction, productivity and quality assurance activities;
- Have the support of the local union, if applicable;

2. Hold meetings between employees and supervisors that allow full discussion of the policy and the plans for implementation;

3. Set concrete goals that address specific operations. Goals give priority to the jobs posing the greatest risk;

4. Commit resources to;

- Train the work force to be more aware of ergonomic risk factors for work-related CTDs;
- Provide detailed instruction to those expected to assume lead roles or serve on special groups to handle various tasks;
- Bring in outside experts for consultations on start-up activities and difficult issues until you develop in-house expertise;
- Implement ergonomic improvements as they are required;
- Provide release time or other compensatory arrangements during the workday for employees expected to handle assigned tasks dealing with ergonomic concerns;
- Furnish information to all those involved in or affected by the ergonomic activities to be undertaken;
- Provide evaluative measures to track the results of the ergonomic process to indicate that progress has been made and if plans need to be revised. Reporting results of the process and publicizing notable accomplishments also emphasize the importance of the process and maintain the interest of those involved.

Employee involvement

Promoting worker involvement in efforts to improve workplace conditions is a critical element to an ergonomics process. It also has several benefits, including:

- Enhanced worker motivation and job satisfaction;
- Added problem-solving capabilities;
- Greater acceptance of change;
- Greater knowledge of the work and organization.

Task force development

Ergonomics issues typically require a response that cuts across a number of organizational units. An ergonomics task force provides an excellent forum to secure input and cooperation from these units. In addition to management and the work force, secure participation from:

- Safety personnel;
- Health care providers;
- Human resources personnel;
- Maintenance;
- Purchasing;
- Ergonomics specialists.

Clearly define the roles and responsibilities of each team member, and determine who will document problems and monitor project progress.

Training

Training is an essential element for any effective safety and health program.

Provide training for all staff members to help them:

- Recognize workplace risk factors for CTDs and understand general methods for controlling them;
- Identify the signs and symptoms of CTDs that may result from exposure to such risk factors, and be familiar with the organization's health-care procedures;
- Understand the process the employer is using to address and control risk factors, the employee's role in the process and ways employees can actively participate.

Provide all ergonomic task force members with advanced training in job analysis and control measures, problem identification, team building and problem solving.

Best practices from the BWC SafetyGRANT$ program

The preferred approach to the prevention and control of CTDs is to design the job according to the capabilities and limitations of the work force. Design jobs to minimize CTD risk factors such as high forces, awkward postures and repetitive motions.

BWC's SafetyGRANT$ program has provided assistance to plastics facilities to help them reduce the risk of cumulative trauma disorders (CTDs) in the workplace. As part of the program, BWC has collected sample job designs that plastics facilities have used to reduce the risk of CTDs in their workplaces.

Participating companies report the effectiveness of the interventions by measuring CTD incidence rates, lost days due to CTDs, restricted days due to CTDs and employee turnover. They also measure the relative risk of injury by completing risk factor assessments for affected tasks. These assessments provide a measure of the relative risk of injury for a specific task.

BWC calculated a return-on investment (ROI). Assumptions include:

1) $29,000 per incident (www.backsafe.com);
2) Every dollar saved in injury reduction is available purchasing power to the employer;
3) BWC normalized data to calculate the injuries and costs that would occur in an equivalent one-year follow-up period. In this way, direct comparisons could be made between the baseline and follow-up periods;
4) BWC did not consider the time value of money in the calculations.

Plastics facilities ergonomic best practices

The following are situations frequently encountered in the plastics industry that can lead to CTDs and demonstrated solutions (best practices) to alleviate those problems.

Situation — flash removal or trimming
Flash removal often involves the repetitive use of a knife to cut excess material from the pieces. Knife handles can often put pressure on the hands. Furthermore, awkward wrist postures can be associated with this task. These repetitive motions, awkward postures and pressures can increase the risk of CTDs such as tendon-

itis and carpal tunnel syndrome. The back is also affected; static trunk flexion (bending the trunk forward) is required to do the job. Static trunk flexion has been associated with low back pain.

Best practice — automate flash removal (trimming)
Deflashing fixtures and presses can eliminate the need to cut and pull flashing from plastic products; thus, eliminating the time-consuming task of removing flash by hand. By mechanizing the task, the associated repetitive motions, awkward postures and contact stresses are eliminated, thereby greatly reducing the risk of injury.

Results
The average risk factor assessment scores for tasks at a company that incorporated deflashing fixtures decreased from 32.5 when manually removing flash to 21 after mechanizing the task — a 35-percent reduction.

Situation — secondary operations (assembly)
Secondary operations on plastic pieces are sometimes required. For example, a window manufacturer must use screws to fasten plastic components together. This task exposes workers to repetitive motion (assembling 2,500 screws per day), force on the hands from holding a two-pound pneumatic tool, awkward wrist postures, static loading and a pinch grip when loading holding screws. These risk factors are associated with increased risk of hand and wrist CTDs, including tendonitis and carpal tunnel syndrome.

Best practice — hand tool/workstation design
Use a multi-faceted approach to change the design of the workstation and tools. In this case, the employer implemented the following changes:

- Automatic screw-feeding systems to eliminate the pinch gripping associated with inserting screws;
- Inline screw guns and pistol-grip screw guns so that employees could perform work with the wrist in a neutral posture — in line with the forearm (Please note that the correct tool orientation for a task depends on the height and orientation of the work surface and the work piece);
- Two parallel arm workstations to reduce the torque on the wrist and to eliminate the need for the operator to hold the weight of the tool.

Results

- For the population affected, the CTD rate, lost-days rate and restricted-days rate stayed at 0.
- The ROI for hand tool/workstation design is undeterminable at this time due to lack of data to measure.

- The risk factor scores for this task declined from 25 to 17 (32-percent improvement).
- Productivity: The change resulted in a 25-percent reduction in cycle time.
- Quality: The scrap rate decreased from 10 percent to less than 1 percent.

Situation — mixing
When material is mixed, sometimes employees must lift bags of material and dump it into hoppers. This activity often requires manually carrying, lifting and dumping bags which frequently weigh 50 pounds or more. Carrying, lifting and dumping heavy loads places large forces in the shoulders and back, increasing the likelihood of shoulder injuries and back pain.

Best practice — bulk handling and automated mixing
Implement bulk handling systems, which eliminate the handling of materials and the associated risk factors. Employers can use mixers to eliminate the manual mixing of materials.

Results
One company that instituted such a system found the following results:

- The CTD incidence rate decreased from 78.3 to 20.3 CTDs per 200,000 hours worked (74-percent improvement);
- The ROI for bulk handling and automated mixing is 1.5 years;
- The days lost due to CTDs declined from 392 to 198 per 200,000 hours worked (49-percent improvement);
- The restricted days due to CTDs remained at 0;
- The follow-up turnover rate improved from 141 to 81 per 200,000 hours worked (42-percent improvement);
- The average risk factor score for office tasks was 32 before redesigning the workstations, and 23 after the change (28-percent improvement).

Situation — Bending to reach into containers
When retrieving parts from boxes or bins, extreme trunk flexion (bending) is often present, particularly when the stock is near depletion. This trunk bending, even when there are relatively light weights being lifted, is associated with an increased risk of low back pain.

Best practice — reduce trunk flexion with lift assist devices
Reduce trunk flexion by using lift assist devices to lift, tilt and/or turn the boxes or bins. This enables employees to position parts at the proper height and orientation, reducing the need to bend the trunk and, hence, the risk of back injury.

Results
Of four plastics facilities that installed lift assist devices, the average risk factor scores changed from 44.3 to 20.9 — a 53-percent improvement. Furthermore, the lost-day rate decreased from 87.6 to 33.0 days lost per 200,000 hours worked after the lift assists were installed, a 62-percent improvement.

Situation — reaching under molding machines to retrieve ejected parts
Molding machine operators are often required to reach underneath or into molding machines to retrieve the pieces. This activity requires the machine operator to bend and reach, often in restricted work spaces, to retrieve the pieces. Frequent bending and reaching is a contributor to CTDs, including back injuries.

Best practice — provide conveyors
Provide a conveyor to eliminate the need for the operator to retrieve the pieces. The conveyor can run from where the parts are discharged (usually under the machine) to the end use or storage location. Thus, the bending and reaching is entirely eliminated, as is the risk of injury from this task.

Results
One plastics facility that incorporated conveyors improved its risk factor assessment scores for packing tasks from an average of 24 to 0, since the need to retrieve pieces was eliminated. After one year, the company's CTD rate, lost-days rate and restricted -days rate remained at zero.

Situation — work station design
Many plastics facilities have workstations where parts are cleaned, assembled or packed. The following risk factors are often present at these workstations:

- Prolonged standing on a hard surface. This condition can lead to poor blood flow in the legs, feet, and back, fatiguing the worker;
- Just as prolonged standing can lead to problems, prolonged sitting can also create stresses on the back by forcing the back to curve outward. Seats with inadequate padding and adjustability can also place contact stresses on the legs and buttocks, which impedes blood flow;
- Reaching into small parts bins or boxes often causes the worker to flex the wrist (bend the wrist toward the palm). Frequent wrist flexion is associated with an increased risk of CTDs, such as carpal tunnel syndrome. Reaching can also lead to stresses on the shoulders and back.

Best practice — ergonomic workstation design
You should incorporate good ergonomic principles into workstation design. Provide anti-fatigue floor mats in areas where employees stand for long periods of time. The matting should have beveled edges to avoid tripping, be of sufficient thickness and size and be durable.

Where workers must sit, provide chairs with good ergonomic design features, including:

- Adequate lumbar support;
- Adequate adjustability, especially in height, to fit a wide range of users. The controls should be easy to reach and operate;
- Armrests (unless they become an obstacle when reaching or getting close to the workstation);
- Adequate padding to avoid contact stresses on the legs;
- Stable chair or stool; having a five-footed base helps.

Since prolonged sitting and prolonged standing are both stressful to the body, allow the worker to alternate between sitting and standing whenever possible. Reduce wrist flexion when reaching into boxes by orienting the heights and angles. Furthermore, you can use clips to hold the lids down so that the worker doesn't have to reach around or over them.

Results

- The restricted days due to CTDs for five plastics facilities that engaged in workstation redesign through BWC Safety-GRANT$ went from 127.9 to 87.6 per 200,000 hours worked (32-percent improvement).
- For eight tasks in those plastics facilities, the average risk factor assessment score changed from 33.2 to 24.4, a reduction of 27 percent.

Situation — resin barrel handling
Handling resin barrels in plastics facilities can create extremely large forces on the spine, as the barrels are lifted, rolled and moved. These activities are linked to an increased risk of CTDs, including back injuries.

Best practice — barrel-handling equipment
Install barrel-handling equipment to automatically lift and move barrels; thus, removing the loading on the spine associated with performing the task. You can place the equipment on wheels or attach it to a hoist.

Results
One company that instituted a barrel-handling hoist system found the following results:

- The CTD incidence rate decreased from 15.2 to 0 CTDs per 200,000 hours worked (100-percent improvement);
- The ROI for barrel-handling equipment is 1.8 months;
- The days lost due to CTDs declined from 37.9 to 0 per 200,000 hours worked (100-percent improvement);
- The restricted days due to CTDs remained at 0;
- The follow-up turnover rate improved from 137 per 200,000 hours worked to 50.3 per 200,000 hours worked (63-percent improvement);
- The average risk factor score for office tasks was 323 before redesigning the workstations, and was 21 after the change (67-percent improvement).

BWC SafetyGRANT$ case studies

Can plastics facilities reduce injuries in their workplaces? The answer is, unequivocally, yes. Through the SafetyGRANT$ program, BWC has collected data on the effectiveness of installing ergonomic interventions in plastics facilities' workplaces. The following case studies demonstrate that by incorporating ergonomic best practices into the design of tasks and by using good safety management processes, you can reduce the risk of injuries, including CTDs. Ergonomic best practices worked for them, and they can work for you, too.

BWC has analyzed data on injuries from plastics facilities that have received safety grants to install ergonomic interventions like those mentioned in the best practices described above. These plastics facilities have reported their baseline (before ergonomic intervention) and follow-up (after ergonomic intervention) data, with an average follow-up period of 160 days. Here's what we have found to date:

- The CTD incidence rate decreased from 10.88 to 9.96 CTDs per 200,000 hours worked, an 8.5-percent improvement;
- The restricted days due to CTDs dropped from 152.2 to 95.3 per 200,000 hours worked, a 37.4-percent improvement;
- The average risk factor score (a relative measure of the risk of CTD) for 30 tasks in the 17 facilities changed from 29 (before the ergonomic intervention) to 17.5 (after the intervention), a 41.5-percent improvement.

The best practices described above are just a few of the ergonomic interventions that you can incorporate into plastics facilities. For more information about safety in the workplace or for assistance with your operation, please contact the BWC Division of Safety and Hygiene at 1-800-OHIOBWC, and listen to the options, or visit our Web site at ohiobwc.com.

Magnetic Specialties, Marietta

Situation
Magnetic Specialties produces flexible magnetic stock from raw materials. Mill operators must load the mill by lifting and placing a variety of raw materials into the mill for the milling process. These materials may include bags that weigh up to 52 pounds. Multiple bags are used in each cycle. Workers must lift bags at a height of 5.5 feet to clear the safety bar and place the material on top of the mill rolls. They must often reach for the bags and pick them up at an awkward angle, then move them onto the mill. The mill operator then sweeps the bottom of the mill pan with a long-handled squeegee, scoops the material up and places it back on top of the mill rolls. The mill operator then uses a mill knife to cut the material from off the rolls and rolls the material into pigs, which are fed to granulators to form usable granules. Employees then place the pigs upon an elevated stock table for transfer to the granulator. Risk factors include heavy lifting, reaching, awkward, high forces, and contact stress associated with the operator using hand tools to cut the roll stock from off of the mill and placing the material on a stock table.

Solution
Magnetic Specialties purchased an internal mixer (total cost, $494,300). The mixer performs the same mixing techniques as are done on the mills, eliminating many of the manual tasks. The mixer also extrudes and cuts the finished material into logs that are collected in a large plastic storage bin and transported to the granulators by a tow motor.

Results
- At one year after the mixer was put into place, the incidence of CTDs dropped from 78.3 to 20.3 incidents per 200,000 hours worked — a 73-percent improvement.
- Incidents of days lost due to CTDs decreased from 391.6 to 197.7 days lost per 200,000 hours worked (follow-up period of one year), nearly a 50-percent improvement.
- At one year after the intervention was put into place, the employee turnover rate declined from 141 to 59.9 employees per 200,000 hours worked, an improvement of 58 percent.
- Productivity (measured in average percent billable pounds) increased from 82.2 percent to 87.8 percent within six months, a 6.8-percent increase.
- The scrap rate changed from 18.2 percent to 11.8 percent within six months, a 35-percent improvement.

BC Composites, Medina

Situation
BC Composites is a fiberglass pultrusion manufacturing facility. The primary product is ladder rail for the construction of fiberglass ladders.

Tasks required for the operation included:

1) Manually moving roving creels from shelves so employees can splice them. Each real weighs between 40 and 42 pounds, and some are stored on shelves above shoulder height;
2) Dumping resin from the barrel. The barrels typically weigh between 50 and 100 pounds;
3) Positioning die tooling on the protrusion machine. This activity requires standing on top of the machine, bending over, and removing a die, which can weigh as much as 250 pounds.

Solution
BC Composites purchased two steel safety platforms with handrails to allow workers to move creels from high shelves. The steps provide a stable platform and allow workers to get closer to the creels; thus, reducing awkward postures and forces in the spine. The two ladders cost $214.32.

In addition, BC Composites purchased a crane/hoist system to mechanically move the die tooling and to aid in transferring barrels of resin at the pan area. The hoist greatly reduces the forces on the spine associated with manually performing these tasks. The hoist cost $8,189.

Results

- The average risk factor scores decreased from 28.5 to 14 as a result of the ergonomic interventions, more than a 50-percent reduction.
- The CTD incidence rate dropped from 15.2 to 0 incidents per 200,000 hours worked, a 100-pecent improvement (at six weeks after the intervention).
- The lost days rate due to CTDs changed from 37.9 to 0 days lost per 200,000 hours worked (at six weeks after the intervention), a 100-percent improvement.
- The employee turnover rate for the areas affected by the intervention declined from 136.3 to 50.3 employees per 200,000 hours worked, a 63-percent improvement.

Partners in Plastics, Salem Center

Situation

Partners in Plastics is a manufacturer of blow-molded products, producing products on nine dual-head accumulator blow-molding machines. The machine tenders take the product from the part removers and deflash the excess material and scrap. This process involves the repetitive use of a knife to cut and pull the flash from the product. Some products require additional secondary work such as cutting or drilling operations, assembly, and labeling and packaging. CTD risk factors include repetitive motion, excessive force, contact stresses and awkward hand/wrist postures.

Solution

Partners in Plastics purchased two deflashing fixtures, dies and four adjustable height tables. The fixtures eliminate the need to pull the flash from the product, thus eliminating the repetitive motions and awkward postures associated with manually performing the task. The lift tables allow work to be height adjusted to individual workers so that trunk bending is minimized.

Results

- The average risk factor scores declinded from 31.6 to 22.6 as a result of the ergonomic interventions, a 28-percent reduction.
- The CTD incidence rate dropped from 19 to 9.4 incidents per 200,000 hours worked, a 50-percent improvement (at 11 months after the intervention).
- The lost-days rate due to CTDs decreased from 38 to 12.7 days lost per 200,000 hours worked (at 11 months after the intervention), a 66-percent improvement.
- The restricted-days rate due to CTDs changed from 326 to 87.6 days lost per 200,000 hours worked (at 11 months after the intervention), a 73-percent improvement.
- The employee turnover rate for the areas affected by the intervention declined from 140.3 to 82.3 employees per 200,000 hours worked (at 11 months after the intervention), a 41-percent improvement.