297

AN ERGONOMIC ASSESSMENT OF A THERMALLY STRESSED ENVIRONMENT. R. Handy, T. Whitaker, R. Heltsley, M. Overton, Western Kentucky University, Bowling Green, KY

An ergonomic assessment was recently performed at a frozen foods manufacturing facility located in the southeastern United States. Complaints from employees at the facility ranged from disorders such as carpal tunnel syndrome to other ailments of components of the upper extremities (e.g., fingers, wrist, arm, elbow). Nearly all of the complaints originated from employees in three key areas of the plant. The temperatures ranged from 65°F to below 32°F in those areas, with the production processes being very labor-intensive.

The most effective solution for reducing complex multiple risk factors is by carefully analyzing what is currently being done and then developing the best solution that will ultimately benefit both the worker and the employer. The method used to achieve this solution included 1) an initial walk-through of the facility and interview of the safety staff; 2) research of the literature on comparable ergonomic studies; 3) interviews with affected employees; 4) development and completion of qualitative ergonomic worksheets; 5) videotaping of appropriate jobs; 6) measurement of temperature and humidity conditions; and 7) evaluation of personal protective clothing.

It was concluded that the premature development of occupational disorders such as carpal tunnel syndrome were manifesting due to the synergistic effects associated with cold-stressed, repetitive production environments. A program was recommended that included implementation of appropriate engineering controls and personal protective equipment, coupled with additional minor process changes and an employee wellness program.

298

SHIPYARD CONFINED SPACE WELDING INTERVENTION. S. Wurzelbacher, S. Hudock, O. Johnston, S. Shulman, NIOSH/Division of Physical Sciences and Engineering, Cincinnati, OH; B. Lowe, Division of Biomedical and Behavioral Science, Cincinnati, OH

Shipyard welders, especially those working in confined spaces, have not been adequately studied as an occupational group in terms of ergonomic factors affecting worker health, safety, and performance. These workers can weld under conditions that provide inadequate ventilation and require static muscular work and awkward postures.

This study measured the effect of the welding process and ventilation method used in a confined workplace on physical workload, weld fume exposure, and weld performance. Nine male welders from the participating shipyard performed four wire-fed welding tasks and four stick-welding tasks in a functional mockup, constructed by NIOSH, to match actual dimensions of the double-hull honeycomb (0.6 m × 0.6 m × 4.9 m).

During these tasks, the ventilation method was alternated between a standard air horn and a prototype fresh air diffuser. Heart rate, electromyographic (EMG) activity, ratings of perceived exertion (RPE), discomfort assessment surveys (DAS), total personal particulate concentrations, and area elemental concentrations were recorded for each task. In addition, welding performance in terms of weld quality and efficiency were determined for each task.

Statistical analysis indicated that weld process had a significant effect on workload and weld performance. Wire welding was associated with higher RPEs ($p = 0.0001$), general DAS outcome ($p = 0.0076$), and weld efficiency ($p = 0.0335$), while stick welding was associated with higher weld quality ($p = 0.0001$). EMG analyses showed that stick welding was associated with greater localized muscle fatigue than wire welding. The standard air horn ventilation method was associated with lower total particulate concentrations ($p = 0.0282$).

This study suggested that engineering interventions for confined space welders involving weld process and ventilation method changes should be considered carefully due to potential impact on workload, weld fume exposure, and weld performance.

299

MAQUILADORA AIRBAGS MANUFACTURING AND MUSCULOSKELETAL DISCOMFORT. W. Liu, S. Morales, UCLA-Fogarty International Training Program, Los Angeles, CA

A survey of musculoskeletal discomfort was conducted in an airbag manufacturing facility of the maquiladora system along the United States-Mexico border. A total of 162 operators, randomly selected from operators in eight departments of the factory, participated in a self-administered discomfort survey. Each department fabricates airbags of different designs. Males constituted 36% of the respondents and females constituted 64% of the respondents. The age of the respondents ranged from 16 to 59 years. The respondents' tenures at current job ranged from less than a month to 108 months. Each respondent rated on a 0-5 scale the level of musculoskeletal discomfort he or she experienced in the neck, shoulder, elbow, wrist, hand, and back for a one-month period before and at the time of the survey.

The results showed that 46% of the survey respondents experienced at least some back discomfort; 39% and 27% of the participants experienced at least some shoulder and elbow discomfort, respectively; 38% experienced at least some neck discomfort; and 52% and 43% experienced discomfort in the wrist and hand, respectively. This indicates that musculoskeletal discomfort was a common experience among operators in this particular airbag manufacturing facility.

The period prevalence found in this discomfort survey is greater than those reported in the literature for maquiladora workers involved in other types of assembly operations. Crude analysis showed that the operators in three particular departments were more likely to experience and report musculoskeletal discomfort in the neck and the wrists.

Logistic regression was also used to analyze the data collected from participants with at least one-month job tenure. Adjusted for age and tenure, the results of regression analysis seem to suggest that the fabrication of two types of airbags may be associated with the period prevalence of musculoskeletal discomfort in the neck and wrist in this particular maquiladora factory.

300

MAXIMAL BENEFITS FROM ERGONOMIC JOB ROTATIONS. R. Schwartz, RKS Consulting Services, Inc., San Antonio, TX; C. Simmons, Motorola, Seguin, TX

Stressful postures, overuse of musculoskeletal structures, excessive speed and force are primary "risk factors" for cumulative trauma injuries. Effective job rotations minimize exposure to risk factors and reduce incidence and severity of work-related injuries. An ideal job rotation 1) allows a person to work several hours in one position and then several hours in another; 2) lets the worker use different muscle groups to perform primary tasks of each rotation; 3) uses different amounts of force and effort at each station; and 4) varies hand positions, grasp, and release.

Working without rotating leads to greater, more rapid fatigue, increased buildup of heat and friction, and greater chance of injury. The best rotation pattern is not a "chain," but rather a sequence of moving from one workstation to another in a group of jobs that maximizes changes from one job to the next.

A system that assesses jobs and determines optimal rotation patterns has been developed and tested. Subjects for a three-year study of this instrument worked on a single production line engaged in the assembly of electronic devices. In 1994, there were seven work-related injuries costing $27,645. In early 1995, the computer program designed to maximize changes in risk variables determined an optimal rotation pattern. In 1995, there were six injuries costing $5,191. In 1996, there was one injury costing $190. And in 1997, there was one injury costing $139. This represented a 99.5% reduction in injury costs by the second year of rotation, which by following this pattern was sustained throughout the third year of rotation.

Cross-training of employees is expensive and time-consuming. The availability of a computer program using the matrix algebra needed to select an optimal rotation pattern from thousands of potential patterns ensures that rotations will have maximal impact.

301

ERGONOMICS: A GLOBAL PERSPECTIVE. M. Schneider, Humantech, Inc., Ann Arbor, MI

Many companies struggle with deploying a successful ergonomics agenda in the United States. When these same corporations expand their ergonomics efforts globally, the weaknesses of the domestic programs are amplified and the results are poor. In contrast, several Asian and European corporations have established operations in the United States and their transplanted ergonomics agendas have flourished.

In an effort to capture the best practices from successful global ergonomics initiatives, programs deployed in 18 countries were studied. These countries were:

- American Samoa
- Australia
- Belgium
- Canada
- China
- Costa Rica
- France
- Germany
- Ireland
- Luxembourg
- Malaysia
- Mexico
- Puerto Rico
- Singapore
- South Korea
- Spain
- United Kingdom
- Venezuela

Lessons learned from successful global ergonomics agendas were:

1. Ergonomics is deployed using a standards-based process. Engineering is accountable for deploying the standards in manufacturing and facilities managers are accountable for deploying the standards in the office.

AIHCE 2000

The premier occupational and environmental health and safety conference & exposition

May 20–25, 2000

Orange County Convention Center

Orlando, Florida

Cosponsored by AIHA and ACGIH

PREVENTION —

Our Mission
for the 21st Century

Abstracts