

Ergonomic Analysis of the Coffee Handsorting Workstation

Course:

Ergonomics

MSc. Occupational and Environmental Safety and Health

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Job Analysis – Coffee Handsorting Station

Background

The coffee industry uses workers, mainly females, to sort coffee by removal of defective beans or foreign matter. These defects are comprised of broken or crushed beans, discoloured beans and though which have been poorly processed or imbue taste taints to the final brew. A meticulous hand sorting process can remove virtually all defective beans.

This process of sorting or hand-picking involves removes defective beans by hand. On average a handpicker can sort up to fifty pounds of coffee per day. This work is very tedious and a typical workday lasts between 8-10 hours depending on the processing facility to which they are attached. Workers are given an hour for lunch and have self – regulated breaks. In one processing facility visited, the factory supervisor indicated that workers tend to work through lunch as they are paid by the amount of material they are able to successfully sort for the day.

Handpickers may be at risk of developing work-related musculoskeletal disorders (WMSD's) or suffering muscle fatigue because of the long hours they are required to work in awkward positions at uncomfortable workstations, completing highly repetitive motions. Workplace risk factors, along with health status/ personal limitations and psychosocial factors such as stress are thought to contribute the development of WMSD (US Department of Health and Human Services, 1997).

Methodology

Two processing facilities were visited and observations of the work environment and work practices were made to determine whether there were any ergonomic deficiencies found in the design and use of the handsorting stations.

Interviews of the workers and supervisors were also done to determine whether there were any health issues such as pain, discomfort or musculoskeletal disorders associated with the hand picking activity. Redesign and organizational recommendations were made to address deficiencies found, using appropriate references.

Typical Work Station Design



A typical work station is comprised of a metal or wooden table with a smooth surface for spreading the coffee. The surface is usually black or white, but can also have other finishes. Workers generally sit on non-adjustable metal or plastic chairs, with or without

handles, or on wooden benches. The light source is either natural or artificial lighting or a combination of both. Where artificial lighting is used, *daylight* bulbs placed directly over the work table.

DIMENSIONS:

In this study the average dimensions of the workstation are given below:

- Height from floor to top of table - approximately 27”
- Width of table - approximately 29”
- Depth of table - approximately 19”
- Height of light source from table - approximately 39”

ERGONOMICS RISK FACTORS:

There were several ergonomic risk factors identified for the job/workstation. These include static postures, awkward postures, localized contact stresses, repetitive motions and patterns of work. These factors have all been linked to an increased risk of work-related musculoskeletal disorders (Latko, Armstrong, Foulke, Herrin, Rabourn, and Ulin, 1997) and muscle fatigue (Dennerlein, Ciriello, Kerin, and Johnson, 2003). Repetitive exertions such as the pinch grip motion applied to pick up the beans, have been specifically implicated as a significant contributor to workers developing MSD's. However, although a dose-response relationship is known to exist between exposure to repetitive motion and development of MSD's (Latko et al, 1997), the critical exposure levels at which a worker's risk significantly increases is difficult to quantify. Movement speed and recovery time are also important parameters related to risk of MSD's. In this

study workers complained of pain and/or discomfort in the wrists as well as stiffness in the fingers.

Research done on the prevention of MSD's in garment workers was used as a reference for the evaluation of risk factors in had picking because they have many risk factors in common and there was no study found which looks at this specific group of workers. Garment workers, like hand pickers are required to perform monotonous and high speed precision tasks that require sustained non-neutral joint postures and highly repetitive movements (Chan, Johnowitz, Lashualy, Stern, Kong and Harrison, 2002).

Handpickers remain in static positions for most of the day, removing individual defective beans. They are required to work in the same posture (see Pictures 1 and 2 below) for 8-10 hours per day, at non-adjustable stations. This posture can create a sustained load on the neck and shoulder muscles (Chan et al, 2002). The workers interviewed complained of stiffness and tiredness in the neck and shoulders as well as pain in the lower back and legs. This may be the results of their static, hunched body posture.

The task is visually demanding and requires them to be constantly alert, although it is essentially a monotonous task. This kind of task can cause visual fatigue due to excessive accommodation on the part of the worker in sorting objects which are only a few centimeters in diameter. There were also complaints of tiredness of the eyes and blurring vision, especially towards the end of the day. This situation can be significantly improved by ensuring that there is sufficient lighting, sufficient contrast between the coffee and the

background surface and ensuring that the background is none reflective. Workers should also be encouraged to take frequent breaks.

Another risk factor which has been identified for this work station is the non-adjustable furniture, for which workers have to make some makeshift accommodation (see pictures below). There are no backrests or other back support on the chairs and there is a contact stress between the arms and the edges of the table, which are not cushioned and have very sharp edges. Additionally many of the chairs could not go all the way under the tables because of the armrests. This usually resulted in workers sitting on the edge of the seat, creating even more pressure on the back and legs.

There was a variety of materials used for the work surface; most were either black or white with non-reflective finishes. However this was not always the case and some of the stations had a glare which affected the vision of the workers. Also there were instances when the coffee being sorted was of a very pale hue and therefore there was difficulty differentiating defective beans against the white background.

Ergonomic Issues



1. Awkward postures, no support of back or limbs



2. Flexion in the neck and trunk



3. Need to apply a pinch grip at all times



4. Poor contrast between work surface and coffee being sorted



5. Relatively large volume of material to go through for the day

**SOME ACCOMODATIONS MADE BY THE WORKERS TO MAKE THE
WORK STATION MORE COMFORTABLE**



Chairs are doubled to adjust height/rise



Cushions are placed in the chairs
to relieve pressure on the back



Cushions on the seats to relieve
pressure on the lower back and legs



Alternating between sitting and standing

PROPOSED INTERVENTIONS

There are engineering and administrative controls which can be put in place to improve the ergonomic performance of this workstation. These include:

1. Ensuring that the work area is properly ventilated by increasing the number of windows and wall slots to vent air from inside the room. Overhead ceiling fans should be used instead of standing fans and these will improve circulation and distribution of air within the room.
2. Ensuring that the workstation is adequately lit to ensure that the workers can work with the material without too much difficulty. “Transparent” zinc sheets, if strategically placed, may improve the quality of the lighting. Ensure that “daylight” bulbs are being used in the lamps.
3. Using adjustable chairs which :-
 - a. Is easily height adjustable from a seated position. Heights should be such that the feet are supported on the ground or shorter workers may need foot rests).
 - b. Have the ability to swivel and glide to improve mobility and possibly encourage changes in posture.
 - c. Have cushioned seat and lumbar pads and are covered with material that is easy to clean and breathes well. Seat wedges can be added to support the lower back.
 - d. The edges of the seat should be water fall edges and there should be at least 7” between seat pan and the edge of the table to ensure that there is adequate thigh clearance.

- e. Armrest is present should not cause an interference with the table.
- 4. The width of the table should be increased from 29” and 19” to at least 40” and the depth at least 20” respectively, for seated work (US Department of Health and Human Services, 1997).
- 5. The edges of the table could be cushioned to reduce the contact stress on the arms.
- 6. Use black surface with a non reflective finish to reduce the visual fatigue by reducing glare and providing a good contrast between the coffee and the work surface.
- 7. In terms of administrative controls it is recommended that workers take frequent breaks. A break of at least 5 minutes after every hour of work is recommended similar to the OSHA guidelines for computer user, who are frequently required to remain in static position doing visually demanding tasks. These breaks should be mandatory and not solely self-regulated as they are now. Workers should also be encouraged not to work through lunch.
- 8. Very importantly, workers should be trained in the recognition of risk factors for the development of WMSD’s and should be aware of measures which can be taken to reduce the demands of the tasks.

DISCUSSION

These eight basic interventions, including training for employers and employees in the ergonomic risk factors and their role in the development of WMSD’s can be used to develop a guide for the coffee industry in the design considerations for the handpicking station. The new adjustable chair design will reduce the pressure on the back, legs and on the neck and torso, as the body will be in a more neutral posture.

Improving the lighting and work surface finish should reduce the level of visual fatigue and eye strain suffered by the workers. It may also result in an increase in the pace of work as the coffee will be more distinguishable.

Additionally, frequent rest breaks will reduce monotony of the task as well as provide time for muscle/tendon/ligament recovery, especially in the wrists which are required to be in a pinch grip for most of the work day. This should reduce the incidence of complaints of pain in the wrist and cramping and stiffness in the fingers.

Good engineering design, along with good administrative controls and education programmes are essential to the reduction of the risk of developing WMSD's in this segment of coffee workers. These recommendations should be incorporated into an ergonomics programme which should be integrated into the company safety programme where it already exists.

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APPENDIX 1

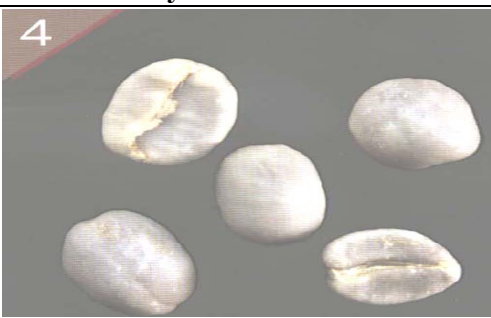
GLOSSARY OF TERMS


Awkward posture:	Posture that strain the neck, shoulders, elbows, wrist, hands or back. Bending, stooping, twisting and reaching are examples of awkward postures.
Contact Pressure:	Pressure from a surface, point or edge on any part of the body.
Dominant hand:	Hand with which the work is done.
Musculoskeletal disorders	Disorders of the muscle, nerves, tendons, ligaments, joints, cartilage or spinal discs.
Static muscle fatigue:	Results when an operator has to hold a posture continuously and cannot fully relax between tasks.

APPENDIX 2

GUIDE TO SOME COFFEE DEFECTS

Type of Defect:		Impact on Coffee Quality	
Full Black or Partly Black bean			
<div>1</div> 	Does it affect? FLAVOUR		YES
	Does it affect? AROMA		YES
	Does it affect? APPEARANCE		YES
	Origin and causes of defects		
	1	Climate	YES
	2	Growing	YES
	3	Harvesting	NO
	4	Pulping	NO
	5	Fermentation	NO
	6	Washing	NO
	7	Drying	NO
	8	Finishing Works (Hulling, Grading & Sorting)	NO
	9	Storage	NO

Type of Defect:		Impact on Coffee Quality	
Crystallized Bean			
<div>4</div> 	Does it affect? FLAVOUR		CAN
	Does it affect? AROMA		NO
	Does it affect? APPEARANCE		YES
	Origin and causes of defects		
	1	Climate	YES
	2	Growing	YES
	3	Harvesting	NO
	4	Pulping	NO
	5	Fermentation	NO
	6	Washing	NO
	7	Drying	YES
	8	Finishing Works (Hulling, Grading & Sorting)	NO
	9	Storage	NO

Type of Defect:		Impact on Coffee Quality	
Pressed or Crushed Bean			
<div>13</div> 	Does it affect? FLAVOUR		CAN
	Does it affect? AROMA		NO
	Does it affect? APPEARANCE		YES
	Origin and causes of defects		
	1	Climate	NO
	2	Growing	NO
	3	Harvesting	NO
	4	Pulping	YES
	5	Fermentation	NO
	6	Washing	YES
	7	Drying	YES
	8	Finishing Works (Hulling, Grading & Sorting)	YES
	9	Storage	NO