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COTTON BROTHERS BAKING COMPANY
ALEXANDRIA, LOUISIANA

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I. SUMMARY

On August 23, 1991, the National Institute for Occupational Safe Health (NIOSH) received a request for a Health Hazard Evaluation at the Cotton Brothers Baking Company (CBBC) in Alexandria, LA. request, initiated by the Bakery, Confectionery, and Tobacco Wor (BCTW) Union Local #149, asked NIOSH to evaluate employee exposu high temperatures. The request stated that about sixty employee potentially exposed to excessive heat loads for an average of 8- hours per day.

On September 25-26, 1991, the NIOSH investigator conducted an in survey at the CBBC bakery. This survey included: inspecting the facility to identify potential high heat stress locations and activities, reviewing the facility ventilation system and heat c efforts, interviewing workers regarding heat stress, environment monitoring to assess heat loads, and reviewing accident and illn records to obtain historical information on heat stress issues a facility.

Potential high heat load conditions could occur at various areas bakery's three production lines. These areas include the locati where product enters and exits the proofing and baking ovens; pa storage areas; the bread "lidding" line; the mixer area; and the molder, twister, and divider operations. Specific job titles of concern are the Oven, Divider, Molder, Pan-Off, Pan-On, and Lidd operators. The facility has no cooling air-conditioning system production areas. Ovens ventilate directly outside through dedi exhaust systems. There are a series of 20 axial roof fans that continuously. The make-up air system, however, appears to be insufficient. Comfort fans are provided in some areas. A heat program has not been established at the CBBC facility.

Confidential interviews were held with eighteen production emplo from a variety of areas. None of the employees interviewed had received any training on heat stress. Eleven of 18 employees (6 indicated they had occasionally experienced health symptoms asso with heat stress (nausea, cramps, excessive fatigue, weakness). employees interviewed said they had access to fluid replenishmen thirsty. The employees' primary concern was the removal of comf fans from certain areas of the facility.

Wet Bulb Globe Thermometer (WBGT) readings were below the NIOSH Recommended Exposure Limit (REL) for acclimatized workers for al conditions and times monitored. The highest indoor WBGT reading 26.3°C obtained at the Jet Oven Pan-Off area at about 3:30 PM. Personal monitoring, using a device that measures body temperatu

an ear sensor, was conducted for the Jet Oven operator. This monitoring indicated the worker's core body temperature did not 38°C during the monitoring period. The highest core temperature recorded was 37.5°C at 3:51 PM. However, due to the mildness of outside weather conditions, the environmental monitoring is not considered to represent conditions during hotter months.

There were no recordable incidents (illnesses/injuries) attribut heat stress on the Occupational Safety and Health (OSHA) 200 log 1990 and 1991. There was one Workers Compensation report indica employee required treatment for dehydration in August, 1991. Th were no heat related workers compensation reports for 1990.

Although environmental monitoring did not detect high heat stress conditions during the sampling period, the monitoring is not representative of conditions during hotter months of the year. Inside temperatures will, in general, exceed outside temperatures in this facility. This data, employee interviews, and industry history indicate that high heat stress conditions can occur at the CBBC bakery. Recommendations for implementation of a heat stress management program, conducting a ventilation assessment, development of a policy on comfort fans, and additional heat stress monitoring are presented in the recommendation section of this report.

KEYWORDS: SIC 2051 (Bread and other bakery products, except cook crackers) heat stress

II. INTRODUCTION

NIOSH conducted this evaluation in response to a request from an authorized representative of the Bakery, Confectionery, and Toba Workers (BCTW) Union, Local 149. The request asked NIOSH to con heat stress evaluation at the Cotton Brothers Baking Company (CB Alexandria, Louisiana. Circumstances that prompted this request the removal of comfort fans from various areas of the facility a concern that keeping all windows closed increased the heat loads which employees were exposed.

On September 25-26, the NIOSH investigator conducted an initial at the CBBC facility. An opening conference was held with CBBC management and employee representatives to discuss the purpose a scope of the NIOSH project, and review the history of heat stres issues at the bakery. Following the meeting, a facility tour wa conducted to: review areas of concern, obtain process and facili information, and identify areas and personnel for heat stress monitoring. Both employee and CBBC representatives participated this facility walk-through.

Environmental monitoring was conducted to assess exposure to hea Additionally, employee interviews were conducted and facility he stress control efforts were reviewed. A closing conference was with CBBC and employee representatives to discuss actions taken NIOSH, survey findings, and preliminary recommendations.

An interim report was issued to the requestor and CBBC managemen October 18, 1991. This report summarized the results of the mon and other survey elements, and provided recommendations to addre stress issues at the CBBC facility.

III. BACKGROUND

Facility Description

The Cotton Brothers Baking facility in Alexandria, Louisiana, wa constructed in 1953 to produce consumer bread products for whole distribution. The building comprises approximately 84,000 squar There are three production lines in the facility (5-line, 4-line line). The building is divided into production and warehouse se with administrative offices at the front of the facility. The production and warehouse areas are single-story with a ceiling h of approximately 25 feet. The facility also has a fleet of deli trucks for distributing products to customers, and a maintenance

CBBC employs about 150 production workers distributed over three shifts. The typical work shift is 8-hours; however, employees frequently work beyond their scheduled shift depending on produc

needs. Work shifts begin at a variety of hours, and will often
The facility operates 24-hour per day.

Process Description

Raw materials (flour, salt, yeast, molasses, vegetable oil, vari additives) are received at the back of the facility via truck. ingredients (flour) are stored in silos and distributed by a pne system to the production areas of the bakery. Other ingredients delivered in 50 pound sacks or drums. The required ingredients dough are apportioned in the weighing room. The ingredients are delivered to one of four mechanical mixers for further processin After mixing, the dough is placed in large (3' X 8') containers. ready for use, the dough is sized and shaped (mechanically) and conveyed to proofing ovens. For certain bread products, the dou manually manipulated (e.g. Twister station) to produce the desir shape. After the proofing process, the product is conveyed to o for final baking. The product is then sliced (if required) and or bagged via automated machinery. The finished product is then for delivery to customers.

Potential heat sources present include the ovens (indirect fired direct fired and proofers), baked product and pans. The ovens a insulated and are provided with heat exhaust systems. The prima source of environmental heat associated with the ovens is at the location where product enters and exits the ovens. Pans used fo baking are conveyed to a storage area after the product is remov the pan-off station. These pans are manually stacked for reuse. pans are still hot when stacked, requiring workers to use protec gloves or pan holders. Under routine conditions, a large volume pans are stacked in certain areas (bread line, 4-line, 5-line), a radiant heat source and increasing the heat load in the surrou environment. The storage areas for the bread and 5-line product areas are adjacent the baking and proofing oven, respectively. and hot pans add to the total heat load. On the bread line, cer products require the addition of metal lids prior to baking. Th Lidding line is between the bread proofer and an exterior wall. combination of hot lids, pans, and somewhat confined working qua also creates the potential for high heat loads. Physical exerti required for some tasks will vary depending on how efficiently t process is operating. For example, the Jet Oven Operator will primarily monitor, visually, this baking line. However, rapid m and exertion is required whenever problems occur (e.g., failure bread to separate from pans, conveyor problems). Other tasks (L Pan Stacking) require a more sustained physical effort.

IV. EVALUATION PROCEDURES

The NIOSH investigation consisted of the following items: (1) a of the facility ventilation systems and heat stress control prog (2) environmental monitoring to assess parameters associated wit stress, and identify high heat stress areas and activities, (3) interviews with production employees and CBBC management, (4) a of company records regarding heat stress related accidents or illnesses. Specifics regarding these evaluation elements are as follows:

Facility Ventilation and Heat Stress Control Efforts

To obtain information regarding the facility's ventilation syste CBBC's Chief Engineer was interviewed regarding all air supply, exhaust, heating and cooling systems, including the use of spot fans. Information on recent renovations or modifications was al obtained, as well as planned system changes. A facility review conducted to inspect the exhaust and make-up air systems.

Information on CBBC heat control efforts was obtained from CBBC management representatives, observation of work practices, and a facility inspection. Management representatives were interviewe obtain information regarding worker training programs related to stress, work-rest regimens, frequency of breaks, and the worker clothing policy. Information on engineering controls, such as shielding or the use of fans, was also obtained. During the fac inspection, observations were made regarding the availability of replenishments to workers, the location of fans, and, the presen shielding/insulation of heat sources to reduce radiant heat load

Environmental Monitoring

On September 26, area environmental measurements were obtained a various locations and times throughout the workday to characteri temperatures. Additionally, personal heat stress monitoring was conducted on the Jet-Oven operator. This job had been previousl identified, subjectively, by employees as the "worst-case" heat activity.

Area heat stress monitoring was accomplished with two Reuter-Sto 214 WibGet® monitors. This type of monitor assesses environment by the Wet Bulb Globe Thermometer (WBGT) method. The WBGT is th accepted standard method for determining environmental heat stre The WBGT combines the effect of humidity, air movement, air temp and radiant heat into a single measurement.

Specifications provided by the manufacturer for the Reuter-Stoke 214 monitor are as follows:

Accuracy: ±0.3°C
Sensor Range: 0-100°C
Sensor Response Time: <2.2 minutes (90%)
<4.5 minutes (95%)

The monitors were operated in the automatic logging mode and wer programmed to record the measured parameters at 10 minute interv

WBGT measurements, in conjunction with metabolic heat production can be used to estimate total heat exposure for comparison to recommended standards. During this evaluation, metabolic heat production rates in kilocalories per hour (kcal/hr) were estimat observation of body position and work activities, and compared t standard tables. WBGT and metabolic heat rates are expressed as time-weighted averages. These recommended standards were develo prevent workers from exceeding a deep body (core) temperature of (100.4°F).[1-4]

Areas monitored using the Reuter-Stokes WibGet® were as follows:

1. Jet Oven
2. Pan-off (Bread Line)
3. Pan-off (Bun Line)
4. Twister/Molder/Divider Station
5. Lid Man Area
6. Mixers
7. 4-Line
8. Break Room

The WibGet® units were placed as close as possible to the worker monitors were also placed so that there was no restriction of fr flow around the thermometer bulbs. Before sampling, the wick of wet-bulb thermometer was moistened with demineralized water and thermometer reservoir filled. The monitors were allowed to equi in each area monitored for at least 5 minutes prior to recording readings.

Periodically throughout the day, ambient temperature and relativ humidity measurements were obtained outside with a Vaisala HM 34 Humidity and Temperature meter. Additionally, National Weather temperatures for Rapides Parish, Louisiana, for June, July and A 1991 were obtained. This data was evaluated because heat loads the bakery are influenced by outside climatic conditions.

The personal monitoring was conducted for the Jet Oven Operator Quest QUESTEMP°II® (Quest Electronics, Oconomowoc, WI) Personal Stress Monitor. This device monitors the worker's body temperat the ear canal. The difference between the ear and body temperat are compensated for by calibrating the unit directly to the work oral temperature. A small sensor is placed in the ear canal, vi earplug, which monitors changes in the body's temperature and wi alarm if the level exceeds a pre-set limit (factory set at 38°C, adjustable up to 39°C). The monitor also continuously logs body temperature for subsequent evaluation. The ear mold containing plug and sensor is equipped with a second temperature sensor whi monitors the worker's environment. This sensor provides only an estimate of ambient temperature because the values may be affect the close proximity of the worker's head.

According to the manufacturer, this type of device provides a di estimate of heat stress on a worker. Because the ear canal bord hypothalamus (the body's temperature regulator at the base of th brain), if the ear canal is isolated from the outside environmen sensor will track the temperature of the hypothalamus.

Employee Interviews

Confidential employee interviews were conducted with production personnel. Employees were selected from a list provided by the and by the investigator to ensure as many job categories as poss could be assessed. The purpose of the interviews was to obtain information regarding the following:

1. Extent of worker training on heat stress
2. Worker access to fluid replenishment
3. Primary areas of concern from a heat stress standpoint
4. The occurrence of heat-related, or suspected heat-related, health problems.

Records Review

To help assess the history of heat-stress issues at the facility federally mandated worker illness and injury forms (Occupational and Health [OSHA] 200 forms) were reviewed for 1990 and 1991. A "Recordable" injuries and illnesses must be noted on this form. stress disorders requiring medical treatment, hospitalization, prescribed medication, or a modified work regimen would be consi "Recordable." Additionally, company accident investigation repo workers compensation claims for 1990 and 1991 were reviewed.

V. EVALUATION CRITERIA

General

As a guide to the evaluation of the hazards posed by work place exposures, NIOSH field staff use established environmental crite the assessment of a number of chemical and physical agents. The criteria suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It should noted, however, that not all workers will be protected from adve health effects if their exposures are below the applicable limit small percentage may experience adverse health effects due to individual susceptibility, pre-existing medical conditions, and/ hypersensitivity (allergy).

Some hazardous substances or physical agents may act in combinat with other work place exposures or the general environment to pr health effects even if the occupational exposures are controlled applicable limit. Due to recognition of these factors, and as n information on toxic effects of an agent becomes available, thes evaluation criteria may change.

The primary sources of environmental evaluation criteria for the place are: 1) NIOSH Criteria Documents and recommendations, 2) American Conference of Governmental Industrial Hygienists (ACGIH Threshold Limit Values (TLVs), and 3) the U.S. Department of Lab Occupational Safety and Health Administration (OSHA) standards.[5 Often, NIOSH recommendations and ACGIH TLVs may be different tha corresponding OSHA standard. Both NIOSH recommendations and ACG are usually based on more recent information than OSHA standards the lengthy process involved with promulgating federal regulatio OSHA standards also may be required to consider the feasibility controlling exposures in various industries where the hazardous are found; the NIOSH recommended exposure limits (RELs), by cont are based primarily on concerns relating to the prevention of occupational disease.

Heat Stress: Evaluation Criteria

Heat stress is the total net heat load on the body that results exposure to external sources (environmental heat) and internally generated heat (metabolic heat) minus the heat lost from the bod the environment.[1,3] The environmental factors of heat stress ar temperature and movement, water vapor pressure, and radiant heat Exposure to heat stress conditions produces physiological respon referred to as heat strain and characterized by an increase in: or deep body temperature; heart rate; blood flow to the skin, an water and salt loss due to sweating.[3] These conditions can occu the physical work is too heavy and/or the environment is too hot

The body normally maintains a deep body temperature within narro limits (about 37°C) by means of various adaptive mechanisms to e produce more heat, or rid the body of excess heat. This continu heat regulation is an essential requirement for continued normal function. The most important physiologic responses to heat incl changes in blood flow to the skin, muscular activity, and sweati Under excess heat conditions, blood flow to the skin increases, heat dissipates into the environment. Muscular activity will in if more heat is necessary (e.g., shivering), and will, if possib decrease when less heat is needed. Sweating is a major heat dissipation mechanism that depends on the evaporation of sweat t produce a cooling effect. The rate and amount of evaporation is function of humidity and the speed of air movement over the skin

The major heat exchange mechanisms between the human body and th environment are convection, radiation, and evaporation.[1]

1. Convection heat exchange (C) is the gain or loss in heat as a function of the rate of air movement over the skin and the difference in temperature between the ambient air and the ski When the dry bulb air temperature is lower than the skin temperature (about 35°C), heat is lost from the body. When a temperatures exceed the skin temperature, heat is gained by convection.

2. Radiant heat exchange (R) is the gain or loss in heat by radi from warmer surfaces to cooler surfaces

3. The evaporation (E) of water (sweat) from the skin is an impo cooling mechanism and always results in a net heat loss. In moist environments, evaporative heat loss may be limited by t capacity of the ambient air to accept additional moisture.

The basic equation describing heat balance is:

$$S = M \pm C \pm R - E$$

Where:

S = The net body heat gain or loss
M = Metabolic heat production
C,R,E are described above

Heat acclimatization is the enhanced tolerance to heat acquired working in a hot environment.[(7)] The body's heat adaptive mechan can, through regular exposure to hot environments, significantly increase the ability to tolerate work in heat. This heat acclimatization process can usually be induced in 7-10 days of e to a hot environment.[1] Acclimatized workers can perform with les increase in core temperature and heart rate, and less salt loss, unacclimatized workers.

At this time, OSHA has not promulgated regulations or standards covering heat stress. OSHA has, however, issued a directive to field staff that provides technical information regarding the investigation of heat stress issues in industry.[8] This document heavily on NIOSH and ACGIH criteria. The NIOSH RELs and ACGIH T present recommended heat exposure limits (WBGT) for a variety of rest regimens and worker energy costs (metabolic heat generation This criteria, presented in Figure 1, applies for the following conditions:

a. Healthy workers who are physically and medically fit
b. Workers who are heat-acclimatized to working in hot environme
c. An average worker size of 154 pounds (70 kilograms)
d. Workers who are wearing light summer clothing

If any of these parameters change, modifications must be made to heat exposure evaluation criteria. Values are available for adj for worker weight and additional clothing.[1] In special cases whe vapor-impermeable clothing (e.g., chemical protective suits) is the WBGT is not the appropriate method for measuring environment stress.

NIOSH has also established Recommended Alert Limits (RALs) for h workers who are not acclimatized to working in hot environments. These limits are presented in Figure 2. A ceiling level has bee recommended by NIOSH, for both acclimatized and un-acclimatized workers. Workers should not be exposed to temperatures reaching exceeding this ceiling limit without adequate heat-protective cl and equipment. These ceiling levels are indicated with a C in f 1 and 2.

These evaluation criteria have been established to prevent expos workers from exceeding a deep-body or core temperature of 38°C (100.4°F). This temperature is considered to be a consensus amo physiologists and standard setting organizations as the value be which the body temperature must be maintained to reduce the risk heat illness.[1-4]

Due to the impracticality of monitoring a workers deep body temperature, the measurement of environmental factors that corre with a workers deep body temperature and other physiologic respo heat is necessary. As mentioned, the WBGT is the accepted stand method for measuring these environmental factors for most situat For indoor use, such as the CBBC production areas, only two measurements are needed: the natural wet bulb (nwb) and black g temperatures (g). The calculation for the indoor WBGT is as fol

$$WBGT = 0.7t_{nwb} + 0.3t_g$$

These measurements of environmental heat are expressed as 1-hour weighted averages (TWAs).

As both metabolic and environmental heat together determine the heat load, the work load category of each task must be establish determine the applicable heat exposure limit. For this evaluati metabolic heat rates for each task monitored were estimated from established references (Table 3).[1,3] This was accomplished by observation of the worker performing the task, and categorizing position, type of work, and degree of work-rest regimen (e.g. continuous, 50%, etc.). Metabolic heat production was then esti in kilocalories per hour (kcal/hr).

The WBGT measurements, estimates of metabolic heat production (kcal/hr), and the degree of work-rest regimen were used to dete the appropriate REL for each task monitored.

Heat Stress: Effects of Exposure

When heat gain exceeds the ability of the body to compensate thr heat loss mechanisms, the core temperature will begin to rise an stress disorders are possible. There are a variety of outcomes could occur, ranging from somewhat mild behavioral disorders (he fatigue) to very severe health problems such as heat stroke. In addition to the environmental temperatures and metabolic rates, are numerous other factors that will influence the potential for related disorder to occur. These include the following:

1. Fluid intake and electrolyte replenishment
2. Degree of acclimatization
3. Diet
4. Age
5. Gender
6. Body Fat
7. Alcohol and drug (therapeutic and social) use
8. Individual variation
9. Physical fitness

The primary physical disabilities caused by excessive heat expos are, in order of increasing severity, heat rash, heat cramps, he exhaustion and heat stroke.[9]

Heat Rash

Heat rash ("prickly heat") occurs as a result of unrelieved expo humid heat with the skin continuously wet with unevaporated swea This often occurs when clothing traps moisture against the skin. sweat gland ducts can become plugged which leads to inflammation glands. This causes profuse, visible, tiny red vesicles in the affected skin area and can substantially impair sweating. There it is not only a nuisance due to discomfort but can diminish the workers capacity to tolerate heat.

Heat Cramps

Heat cramps can occur after prolonged exposure to heat with exte perspiration and inadequate replacement of salt. Cramps usually in the abdomen and extremities.

Heat Exhaustion

Predisposing factors for heat exhaustion include sustained exert a hot environment, lack of acclimatization and failure to replac and/or salt lost in sweat. These factors can result in dehydrat depletion of circulating blood volume and circulatory strain fro competing demands for blood flow to the skin and active muscles.

and symptoms include fatigue, nausea, headache and giddiness. T may be an increase in body temperature. The affected individual will be clammy and moist.

Heat Stroke

Heat Stroke is considered a serious medical emergency. A major predisposing factor is excessive physical exertion in a hot environment. Classical heatstroke includes (1) major disruption central nervous function (convulsions, unconsciousness); (2) a l sweating; and (3) a very high body temperature (>105°F). Signs symptoms may include dizziness, nausea, severe headache, hot dry (due to cessation of sweating), confusion, collapse, delirium, a coma. If cooling of the victims body is not started immediately irreversible damage to vital organs may develop.

In addition to the above, prolonged exposure to excessive heat m cause increased irritability and anxiety, decreased morale and a inability to concentrate. This often results in a general decre production efficiency and quality.[9]

VI. RESULTS AND DISCUSSION

Facility Ventilation and Heat Control Programs

Facility Ventilation

The facility has no air conditioning system for production or wa areas. Heaters are available for use during the winter months. Jet Oven (indirect fired heater: 350°-425°F), Bun/Bread Proofers (110°F), and Direct Fire Bread Oven (325°-460°F) are ventilated directly outside (roof) through dedicated exhaust systems. Ther 20 axial roof fans over the production area, uniformly spaced, t operated continuously. The intent of these ventilators is to re excess heat. Information regarding the capacity of these fans w available for review at the facility. A make-up air-handling sy was added to the back of the facility to help prevent condensati forming on the ceiling. This system is rated at 40,000 Cubic Fe Minute (CFM) and takes air directly from outside (roof level). is filtered and delivered into the facility at the ceiling. Thi incoming air can be heated if necessary. Supply vents from the air system are about 5 feet below ceiling height (20 feet from t floor). Other make-up air is provided by a series of roof-mount intake vents (passive) positioned on each side of the production For sanitation reasons, windows and doors are kept closed.

The make-up air system appears to be insufficient. This was evi by the noticeable air movement entering the production area thro large entrance into the adjoining warehouse. When the warehouse loading doors are open, the velocity of air movement through thi entrance increases (subjectively determined). This situation is created because of the high capacity of the roof ventilators and oven exhaust systems. It is likely that the roof ventilators ar "starved" and not performing efficiently. Additionally, the pre of the make-up air vents adjacent the roof ventilators may be cr a "short-circuit" situation in which outside air enters through vents and is immediately ventilated outside. This could reduce fans' ability to remove heat near the floor of the building.

Heat Control

Comfort fans are used in some areas to provide heat relief to employees. Areas where these fans are present include: bread pa storage, molder/twister/divider area, and the bread lidding area had been provided in other areas (jet oven, 5-line pan-off, 4-li were removed by CBBC management. CBBC representatives stated th were removed in consideration of sanitation requirements, health due to dust generation, and the inability to control the use of (employees moving fans to other areas). The removal of these fa certain areas created a high level of concern among employees of bakery. Union representatives issued a letter to management and employee petition was sent to management requesting return of th

Cold water fountains are available in several production locatio (mixing, receiving, wrapper). A break room, at the front of the production area, is provided. Employees are allowed a 15 minute every 2 hours (3 breaks per 8-hour shift). This includes lunch separate meal breaks are not provided. The break room is separa from the production area. The room is equipped with a ceiling f air-conditioner. However, during the time of this investigation air-conditioner was not operating.

Employees in the production areas wear CBBC provided clothing consisting of hair-nets or caps, short-sleeve light cotton shirt pants.

A heat-stress program has not been established at the CBBC facil There is no formal worker training, acclimatization, or medical monitoring program addressing heat stress for bakery employees. employees are informed they will be working in hot environments an orientation process.

Environmental

Area Measurements

Table 1 depicts the results of the area environmental heat stres monitoring, and corresponding Recommended Exposure Limits (REL). previously discussed, these RELs apply to healthy, acclimatized

wearing light summer clothing, conducting work on a continuous b
It should be noted that these RELs are based on an average worke
weight of 154 pounds (70 kilograms). The REL for workers exceed
this weight must be adjusted accordingly. For instance, the emp
conducting the bread-pan stacking operation on the morning of Se
26 weighed about 240 pounds. The REL for this employee would be
reduced from 28°C to 25.5°C.

Additionally, the effect of worker metabolic rates on the REL ca
seen in this table. The metabolic rate estimate for the Lidding
operation worker was higher than other tasks because of the rapi
rate and whole-body movement involved with this job. Conversely
REL for the break-room is higher (32°C) as metabolic heat produc
for employees in this area is low.

The monitoring results show no overexposures to heat during the
period sampled. However, the heat loads in the production area
significantly affected by outside climatic conditions. On the d
the monitoring, outside conditions were optimum (mild temperatur
humidity). Therefore, the monitoring results are not representa
environmental heat loads that would occur during hotter times of
year. The following table depicts the outside temperature (dry
and relative humidity during the day of the monitoring, and
corresponding dry bulb temperatures in the production area. Ave
temperatures for the months of June, July and August, 1991 for R
Parish are also shown.

Time	Outside Temp(°F), %RH.	Inside Temp(°F)	Average Daily Temperatures (Max/Min) and Monthly High
0747/	66° 64%	69°	June: 89.4°/70.7°/ 94°
0940	74° 44%	74°	July: 92°/72.2°/96°
1240	85° 34%	88°	August: 89°/70.5°/96°
1520	82° 36%	94°	

1. %RH = percent relative humidity
2. Average daily temperatures obtained from the National Weather Service

Personal Monitoring

The employee monitored was a 42 year old, 165 pound male. He wa
scheduled for a 10 hour shift (13:00 - 23:00) on the day of the
monitoring. He wore the standard, bakery provided, clothing. H
duties consist of monitoring the Jet Oven and de-pan station, se
up the 5-line proofer and maintaining a clean area. During the

monitoring, the employee conducted sweeping around the Jet Oven first 45 minutes of the sampling period. The remainder of the w shift consisted of monitoring product. No breaks were taken dur sampling period.

The personal monitoring results are shown in Table 2. The monit began alarming (indicating a core temperature exceeding 38°C) ve after the employee arrived at his work station (approximately 13 The monitor continued to periodically alarm although the employe work-rate and the ambient WBGT monitoring did not indicate a hig stress condition. After the employee came back from a break (1 the unit was re-calibrated and a significant difference (-3.7°C) between his original oral-ear temperature measurement and the ne calibration measurement was noted. Quest technical representati were consulted to determine the reason for the initial alarms, a a subsequent re-calibration was required. Quest representatives explained this was because the initial calibration took place in conditioned environment (office), without allowing for adequate stabilization of temperature sensors in the work area. For this reason, the first 80 minutes of monitoring data were invalid and therefore are not included in Table 2.

The monitoring indicates that the worker's core body temperature not reach 38°C at any time during the sampling period. The high recording was 37.5°C at 15:51. The worker's activity was light the sampling period and there were few instances when exertion w necessary. Therefore, metabolic heat production by the worker monitored was low during the sample period. These results corre with results obtained from the WibGet® monitoring. As with the measurements, this monitoring is not considered representative o conditions that would be present during hotter time periods. Additionally, the effect of higher metabolic heat rates during p when considerable exertion is necessary at this station (e.g., m problems requiring manual handling of product) could not be dete

Figure 3 summarizes the personal and area heat stress monitoring results.

Employee Interviews

Results

A total of eighteen employee interviews were conducted. Job tit the workers interviewed were:

Mixer	Wrapper
Bread Panner	Molder/Twister
Pan-off 5-Line	Divider
Break Man	Jet Oven Operator
Model K Operator	Pan-on 5-Line

Lid Man
Wrapper Helper
Pan Operator, 4-Line

The average length of employment of the workers interviewed was years (range 1-27 years). The results of the interviews are as follows:

1. None of the 18 employees interviewed had received training on stress.
2. 11/18 employees (61%) stated they had, at some time, experien health symptoms associated with heat stress (nausea, cramps, excessive fatigue, weakness).
3. According to the employees, the hottest jobs in order of prio were: Pan-off Area, Jet Oven, Molder Twister Area, 4-Line, L Area, and Mixer Area.
4. All employees interviewed said they had access to cold water thirsty.

Discussion

The most frequent issue raised by employees concerned the recent removed comfort fans. Employees had not received adequate communication regarding this issue and did not understand why th were removed. The presence of fans in some areas creates the perception of inconsistency which increases employee concern. Employees interviewed indicated that they "sweat less" when the were present, and that they felt cooler. It is probable that em actually perspired more with the fans present, but the air veloc created by the fans served to remove generated perspiration at a rate, thus increasing evaporative heat loss to cool the body.

One employee interviewed (bread line pan stacker) stated that af being on vacation for about 1 month, he returned to work and experienced adverse health effects due to excessive heat. The e reportedly had to leave his work station and lie down to recover effect could have been due to the employee's loss of acclimatiza heat while on vacation. When the employee returned to work, his tolerance to heat stress was diminished, and he was unable to pe his work without being affected.

Records Review

There were no illnesses/injuries related to heat stress recorded OSHA 200 logs for 1990 and 1991. There was one worker compensat report (August, 16, 1991) where an employee was diagnosed as suf from dehydration while stacking pans. Discussion with CBBC representatives regarding this incident indicates that the emplo new to the company (date of hire = 5/31/91), and new to the area he suffered the dehydration. This incident may also reflect a p lack of acclimatization for this worker. There were no workers compensation reports for heat related disorders in 1990.

VII. CONCLUSIONS

Although the monitoring data did not indicate high heat stress conditions during the sampling period, the monitoring is not representative of conditions during the hotter months of the yea monitoring data does indicate, however, that inside temperatures in general, exceed outside temperatures. This data, employee interviews, and industry history indicate that high heat stress conditions can occur in the CBBC bakery.

VIII. RECOMMENDATIONS

1. Develop and implement a heat stress management program at the facility. A good heat stress management program should encom the following items:

   (a) Training of employees in safety and health procedures for in hot environments, including the signs and symptoms of impending heat illness and initiation of first aid and/or corrective procedures. Additionally, the effects of non-occupational factors such as drugs, alcohol, obesity, etc. tolerance to occupational heat stress should be covered. need for fluid replenishment, and that reliance on the thi mechanism is insufficient, are other important elements of worker heat stress training.
   (b) Limiting exposure time to hot environments (e.g. schedulin jobs for the cooler parts of the day, altering the work-re regimen, etc.).
   (c) Ensuring all workers are fully acclimatized for working in environments. Acclimatization efforts should begin at the start of the hotter months of the year, and should include new employees and employees returning from vacation or new transferred to a hot area. Note that there is a wide difference in the ability of people to adapt to heat. In general, for workers who have had previous experience with job, the acclimatization regimen should be exposure for 50 day 1, 60% on day 2, 80% on day 3 and 100% on day 4. For workers the schedule should be 20% on day 1 and a 20% incr on each additional day.
   (d) Implementation of a Heat-Alert Program (HAP) for predicted spells. This program should be used to alert workers of impending hot spells, and initiation of heat control effor (e.g. additional breaks, increased ventilation, shorter wo cycles).
   (e) Medical screening of workers to eliminate individuals with heat tolerance. The capacity to tolerate heat has been sh to be related to physical fitness (the higher the degree o physical fitness, the greater the ability to tolerate heat physical work capacity (those with low physical work capac

are more likely to develop higher body temperatures than a individuals with high physical work capacity). Medical screening should also include a history of any previous he illness. Workers who have experienced a heat illness may less heat tolerant.

(f) Ensuring the worker break area is continually conditioned maintain a cool environment.

NIOSH has available publications that provide additional information on heat stress management programs. This informa was provided to Union and CBBC Management representatives dur the evaluation.

2. Evaluate the efficiency of the facility make-up air system (ventilation engineering assessment) and implement corrective measures if necessary. The roof exhaust fans may be air "sta or operating on a "short-circuit" with the make-up air vents.

3. Develop a formal policy on comfort fans. This item is a sour considerable concern and confusion for employees. Resolve housekeeping issues if they are prohibiting the use of fans i certain areas. The use of comfort fans for spot cooling of w can be an effective low cost approach to controlling convecti heat exchange. Convective heat exchange refers to the heat g loss that occurs between air and the body. The rate of heat is dependant on the difference between the air and skin temperature, and air velocity.

   If the air temperature is less than the skin temperature (abo 95°F), increasing air movement across the skin will increase rate of body heat loss. If the air temperature is greater th skin temperature, air velocity should be reduced to levels th will still permit sweat to evaporate freely, but will prevent convective heat gain.

4. Consideration should be given to the use of windows to help w heat control efforts. If sanitation rules permit, opening wi during hot periods will serve to enhance building ventilation exchange rates and heat removal. This would specifically hel 4-Line area due to the proximity of this line to windows. Wi filters/screens or exhaust fans on windows should also be considered.

5. Heat stress monitoring during the hotter times of the year sh be conducted. This will provide information on the actual temperature extremes being experienced by employees. This da would be useful in refining the heat stress management progra identifying target areas for control and, evaluating the effectiveness of implemented controls.

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For the purpose of informing affected employees, copies of this shall be posted by the employer in a prominent place accessible employees for a period of 30 calendar days.

TABLE 1
COTTON BROTHERS BAKING COMPANY
ALEXANDRIA, LOUISIANA
RESULTS: AREA HEAT STRESS MEASUREMENTS
SEPTEMBER 26, 1991

LOCATION	#WORKERS	TIME	WBGT/TWA[1]	REL[2]
WIBGET #1				
Bread Pan Stacking (on conveyor stand)	2-4	0723-0900	17.3	28
Molder/Divider/Twister Area	2-4	0900-1015	17.9	28
Bread Lidding Area	1-2	1015-1100	21.4	26
		1100-1200	23.1	
		1200-1300	23.8	
Bread Pan Stacking (on conveyor stand)	2-4	1300-1325	22.4	28
Bread Pan Stacking (conveyor corner)	2-4	1325-1425	24.4	28
		1425-1515	25.0	
4-Line Catwalk over conveyor line	5-6	1515-1615	22.8	28
		1615-1715	22.6	
		1715-1815	22.2	
		1815-1850	21.7	
WIBGET #3				
De-panner station at the Jet Oven	2-3	0715-0815	18.5	28
		0815-0910	19.6	
5-Line Pan-on/Pan-off area	3-4	0910-1010	20.4	28
		1010-1140	21.7	
Break Room	6	1140-1230	23.2	32
Mixer area-adjacent Mixer #2	2-3	1230-1355	23.2	28
De-panner station at the Jet	2-3	1355-1455	24.6	28
		1455-1555	25.9	
		1555-1655	25.4	
		1655-1755	24.9	
		1755-1850	23.6	

NOTES:

1) WBGT = Wet Bulb Globe Thermometer/Time-Weighted Average in degrees centigrade. These are approximately hourly TWAs based on a series of 10-minute integrated measurements recorded by the WibGet®.

The WBGT measurement is, for indoor applications, a combination of the natural wet bulb (NWB) temperature and the Globe Temperature (GB). The WBGT is calculated as follows:

WBGT (indoor) = 0.7 NWB + 0.3 GT

This measurement incorporates the environmental factors of air temperature and movement, humidity and radiant heat.

2) REL = NIOSH Recommended Exposure Limits to heat stress for acclimatized workers. These REL's are determined from a combination of WBGT environmental measurements and estimates of worker energy costs (metabolic heat generation). These REL's apply for the following conditions:

a) Acclimatized, healthy workers
b) Average worker size of 154 lbs (70 kilograms).
c) A continuous work regimen
d) Workers wearing light summer clothing

TABLE 2
COTTON BROTHERS BAKING COMPANY
ALEXANDRIA, LOUISIANA
PERSONAL MONITORING RESULTS: HEAT STRESS
SEPTEMBER 26, 1991

JET OVEN OPERATOR

Time Hr:Min	Ear Temp. °C	Ear Temp. °F	Mold Temp °C	Mold Temp °F
14:31	37.1	98.8	32.6	90.8
14:41	37.3	99.2	33.1	91.7
14:51	37.2	99.0	33.7	92.7
15:01	37.3	99.2	33.4	92.1
15:11	37.0	98.6	32.6	90.8
15:21	37.0	98.6	32.7	90.8
15:31	37.2	99.0	33.8	92.8
15:41	37.3	99.2	34.4	93.9
15:51	37.5	99.5	34.1	93.4
16:01	37.0	98.6	32.3	90.2
16:11	37.2	99.0	33.8	92.8
16:21	36.3	97.4	29.5	85.0
16:31	36.6	97.9	30.5	86.9
16:41	36.9	98.4	32.7	90.8
16:51	37.1	98.8	33.4	92.2
17:01	37.0	98.6	33.8	92.8
17:11	37.1	98.8	33.3	92.0
17:21	36.9	98.4	32.5	90.6
17:31	37.3	99.2	33.4	92.2
17:41	37.1	98.8	33.2	91.8
17:51	37.0	98.6	33.2	91.8

18:01	37.1	98.8	33.2	91.8
18:11	36.9	98.4	32.5	90.5
18:21	36.7	98.1	32.2	90.0
18:31	36.8	98.3	32.3	90.2
18:41	36.8	98.2	32.0	89.7
18:51	36.8	98.3	32.4	90.4

NOTES:

Sampling conducted with a QUESTEMP II Personal Temperature Monitor, Se
Number: JU1090012 Software Version Number: 1.3

Start Time: 14:31 End Time: 18:57 Total Run Time: 04:25:50

Alarm Level Setting: 38.0°C
Sample Rate: 10 Min.

High Temperature:	37.5°C	At Time:	15:51
Low Temperature:	30.4°C	At Time:	18:57

CAL in degree C	@ Time
0.3	14:32:41

Calibration = oral temperature - ear temp

Oral Temperature = 37.1°C, 98.7°F at 14:31

Ear Temperature = Temperature measured by the ear sensor corrected for calibration offset. Considered representative of core temperature.

Mold Temperature = The temperature recorded by a second sensor locatec earmold and is an "indicator" of the ambient temperature in the monitc employees area. These measurements are considered an indicator only a temperatures may be affected by the close proximity of the head.

Table 3
HETA 91-358

Estimating energy cost of work by task analysis

A. Body position and movement		kcal/min*
Sitting		0.3
Standing		0.6
Walking		2.0-3.0
Walking uphill		add 0.8 per meter ri
B. Type of work	**Average kcal/min**	**Range kcal/min**
Hand work		
light	0.4	0.2-1.2
heavy	0.9	
Work one arm		
light	1.0	0.7-2.5
heavy	1.8	
Work both arms		
light	1.5	1.0-3.5
heavy	2.5	
Work whole body		
light	3.5	2.5-9.0
moderate	5.0	
heavy	7.0	
very heavy	9.0	
C. Basal metabolism	1.0	
D. Sample calculation**		**Average kcal/min**
Assembling work with heavy hand tools		
1. Standing		0.6
2. Two-arm work		3.5
3. Basal metabolism		1.0
Total		5.1 kcal/min

* For standard worker of 70 kg body weight (154 lbs.) and 1.8 m^2 body surface (19.4 ft^2).
** Example of measuring metabolic heat production of a worker when performing initial screening.