Joint International Conference

APCHI-ERGOFUTURE-PEI-IAIFI 2014

"With new mind set and widen horizon to catch the future: Physiology is the basic science for human life"

UDAYANA UNIVERSITY, DENPASAR – BALI – INDONESIA

OCTOBER 22-25, 2014

Proceeding

Section II - Ergofuture

BALI 2014

ISBN - 978-602-294-020-3

Proceeding
Joint International Conference
APCHI-ERGOFUTURE-PEI-IAIFI 2014

SECTION II : ERGOFUTURE

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Udayana University Press
2014

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WELCOME FROM CONFERENCE CHAIR

Om Swastyastu,

Based on long experiences working in Human Computer Interface (HCI), Ergonomics (Erg), physiology, occupational safety and health (OSH), up to now we are practically still running at the same place. Accident or occupational diseases in fact still happening, even in the workplace equipped with up to date regulation and personal protected devices. Unsafe acts and unsafe behavior must be managed to develop safety behavior. Mindset changes become an important issue to be success. To solve that problem. Balinese Branch of Indonesia Ergonomics Society supported by APCHI, PEI, IEA, IAIFI, Center of Ergonomics Study of Udayana University and Bali Human Ecology Study Group (BaliHESG) organize the Joint Internasional Conference APCHI-ERGOFUTURE-PEI-IAIFI 2014. The conference will be held at Udayana University at Jl. P.B Sudirman, Denpasar - Bali on 22 – 25 October 2014.

The goals are. 1. To provide guidance and direction for young ergonomists, 2. To show the unfit, improper, inappropriate research and application of ergonomics, physiology, computer interface, and OSH, 3. to convince that a total and a more strategic approach must be done in conducting research and application with aimto have maximum benefit.

The scientific program of APCHI-ERGOFUTURE-PEI-IAIFI 2014 including : 1) workshops and tutorials, 2). Keynotes address, 3) Free communication (parallel session) of various topics of physiology, human computer interface, ergonomy in small scale industries, children, women, cognitive ergonomy, MSDs, office, communities, agriculture, architecture, etc. and 4) Field Visit and Tour to Bali best tourism object (on request). To make the conference more successfully, the organizing committee invited overseasparticipants to participate in the conference. Bali is a paradise island with unique attraction culture shall becoming unforgettable experience to all participants.

Om Shantih, Shantih, Shantih Om,

Conference Chair
Dr. Ir. Putu Gde Ery Suardana, M.Erg

GREETINGS AND BEST WISHES TO THIS CONFERENCE

Dear Hosts, Conference organizers, colleagues, and friends,

I would like to use this opportunity to express my congratulations to you for all your efforts and hard work to organize such an important event. Your dedication for promoting ergonomics discipline and profession as well as sharing and enlarging ergonomics knowledge has resulted in this well-organized conference with great contributions. I attended a previous APCHI-ErgoFuture Conference back to 2010, I was positively impressed with the work done by Indonesian scholars.

It is impressive to see how Indonesian researchers dedicate their work on solving local ergonomics needs while reaching out to the world. I truly support your efforts to apply ergonomics knowledge to the priority needs of the local and national community. I recognize clearly the great commitment of the organizers in continuing their efforts of hosting this conference again in four years short. It is equally important to satisfy local ergonomics needs and to network the international ergonomics community.

This conference hold in Bali, Indonesia, has served as an important platform for local and foreign participants to communicate, exchange knowledge and experience, as well as discuss and realize new ideas and mutual cooperation. It is an important event for the big ergonomics family, and is shaping the future development of ergonomics not only in this region but also globally. I hope our efforts could continue and make this conference in a regular basis, so the experience of the pioneers and their contributions could be carried over from generation to generation. Let this event be a place where we will regularly see old friends and meet new friends. Please accept my congratulations and best wishes to the success of our hosts' efforts and this conference!

Eric Min-yang Wang
President, International Ergonomics Association

CHANGING MIND SET AND WIDENING THE HORIZON TO ACHIEVE BETTER FUTURE

Recently we are facing various complex development problems which should be anticipated, - within our limitation -, in attaining our goals to enhance the quality of life and working life of the people at large. Impacts of Globalization, Global Warming, Eruption, Earthquake, 24 hours society, flooded area, drinking water shortage, are some of the problems we have to face and to anticipate.

And for a small island with all its limitation, likes Bali, in anticipating all those problems should be able to carry out a smart and wise development policy, likes to conduct "Development for Bali" and not "Development in Bali". There is no choice for Bali except to carry out sustainable development, using the three economic potentials: agriculture, tourism and small scale industry in synergist as means to attain the goals. To be different and winning the competition, cultural tourism must be utilized in developing tourism. Agriculture and Small scale industry should be able to show its consistency as the backbone of Bali's economy in crisis.

In all those activities ergonomists and ergonomics associations should be able to give their strong contribution and should be able to play a role as playmaker due to its position and strong role in human-machine-environment interface.

As the problems are so complex a Total Ergonomics Approach which consist of SHIP and Appropriate Technology approaches must be utilized. And to conduct such an approach, mind set change of the human resource must be developed. Holistic thinking and act must be empowered. Team approach must be conditioned. Egoism and arrogant attitude must be thrown away.

And through ergo future 2006, 2010 and 2014, we try to aware the problems, to empower the human resource and to enhance the capability of tools to support. Therefore we have to thank everybody who have already given their concerned and commitment to this efforts by supporting the conferences in various means.

We shall not stop the efforts only by organizing conferences, but beyond that. Fundamental efforts have been planted and time to grow it together by academician, government and people at large, has already come.

Finally welcome to all participants in the conferences and let us make a jump in our endeavor to enhance the quality of life and working life of the people.

Please enjoy your visit scientifically and culturally. Thank you.

Prof Emeritus Adnyana Manuaba
Initionator Ergofuture

TABLE OF CONTENT

Proceeding Book : Section II – Ergofuture
International Joint Conference APCHI – Ergofuture – IAIFI
ISBN 978-602-294-020-3

EASUREMENT OF LABOR PHYSICAL AND MENTAL WORK LOAD AT CRUMB RUBBER PRODUCTION LINE IN PT P&P BANGKINANG

Yumi Meuthia, Nilda Tri Putri, Afdal Zikri

Industrial Engineering Department, Andalas University, Padang

RACT: Human resources have a significant role in manufacturing process. Not all the activities anufacturing process can be done automatically. Human workers or labors have several nsibilities in manufacturing process, such as material handling, or problem solving and analysis. b has certain workload and each workload will affect the productivity of a production line. e of the significant roles of human resources at PT P&P Bangkinang are the human workers as erial handling labors (Processing Line 1) and control panel operators (Processing Line 2). To mine the workload of these workers, physiological workload measurement carried out on 6 erial handling labors through measurement of heart rate, energy consumption, and %CVL. nwhile, psychological workload measurement carried out on 5 control-panel operators in using ASA-TLX method. The result of physiological workload measurement shows that workload at first processing line (breaker, press, pull, and cutting workstation) is categorized as moderate workload (approaching heavy workload). The highest workload occurred at cutting workstation, energy consumption of 194.62 kcal/h and 48.62 %CVL which means heavy workload. nwhile, the result of psychological workload measurement at the second processing line cking process, contaminants, and control panel workstation) shows that the highest mental load for these workers is the Frustration level.

rds: physiological workload, psycological workload, material handling, analysis, productivity

NTRODUCTION

Background

worker has somekind of workload in job. Someone is burdened at work the body receives loads from outside, in the form of duties or nsibilities. These loads can be orized as physical or psycological load. From the ergonomic perspective, workload received by a person must ppropriate or balanced in physical ity, cognitive ability, or mental tions of human beings who receive the

erally, workload influenced by many lex factors, such as: (Tarwaka, 2004):

ternal factors

a. Somatic (gender, age, body size, nutrition)
b. Psychological (motivation, perception, confidence, satisfaction).

xternal factors

a. Task (physical task such as working attitude, transportation, the lifting load, then the psychological tasks include job complexity and responsibility)
b. Work organization (working hour, shift, work system and facilities), working condition (physical environment, chemical, biological and psychological condition)

PT P & P Bangkinang is a company that works in manufacturing rubber into crumb rubber. One of the main elements that affect the productivity of the production line at PT P & P Bangkinang is the man that work as a material handling labor (Processing Line 1), and the operator at the control panel (Processing Line 2).

Type of work on the Processing Line 1 associated with material handling and

ISBN 978-602-294-020-3

physical activity, such as lifting raw materials, cutting materials, pushing the material, and moving the material. These job requires physical strength because the material is heavy. The workstations which needs material handling on Processing Line 1 are :

1. Breaker Workstation
   Labor lift up the crude rubber pads to the top of the breaker using a hook conveyor tools. The weight of the raw material is approximately 20-30 kg with continuous removal of frequency. In one work shift, a work station has two workers and only allowed to stop at recess .
2. Milling (Press) Workstation
   Workers who work at this work station lift up the output of the breaker and locate the material to the milling machine. The material should be kept in the same thickness so that it becomes homogeneous and solid. The output of this process called a *blanket*. The blanket is quite heavy due to high water content in the washing process.
   The workers have to maintain the material feeding of the machine in order to avoid bottlenecks. Therefore, the workers do not have a break at work because the material flow does not stop until the break time.
3. Cutting Workstation
   The labor works in a standing position and bent their back to cut the blanket out of the milling machine. The non-ergonomic working position, and high working frequencies caused workers to experienced pain on the waist. After cutting the blanket, workers have to lift the pieces into a reels that will hold 12-15 , each roll of blanket weight approximately about 30-35 kg.
4. Blanket Pulling Workstation
   Workers who work at this work station lift the blanket that had been loaded on to the cart. Blanket that has been processed then transported to the Wind Hanging Room (Kamar Gantung Angin/KGA) by the workers. The loads that should be pulled is approximately 300-350 kg. The distance between the milling workstation to the KGA is approximately 50 meters and the frequency of pulling is continuous and sustained in rapid movement to avoid the blanket pores to stick to each other.

Labors of those four workstations work with a contract system, so that the amount of their daily wages determined by the amount of raw materials that are processed. Thus, workers here work as quickly as possible in order to get processed raw materials and finished on schedule specified by the contract. The contract usually lasts for a year.

Under this system, the company sets the working time of each shift for 7 hours per day. Production activities (shift I) start from 07.00 AM to 4.00 PM, and break time at 12.00 PM to 1.00 PM. The next turn of the second shift starting at 4:00 PM until 11:30 PM, with 30-minute rest period starting at 7:30 PM. But in reality the workers usually would prefer to work overtime (overtime) up to 9 hours per day assuming that they will get more wages. This is contradictory to the government rule (Keputusan Menteri Tenaga Kerja Nomor 51/Men/1999) regulating the Threshold Limit Value for acceptable workplace for labor without causing disease or health problems, is only work for no more than 8 hours a day or 40 hours a week (Kep. Men. Tenaga Kerja No. 51/Men/I999).

Working shift system that is not adjusted to the government rules will cause the workers to absent from work due to illness such as muscle sprains and fatigue. Daily wages system applied also resulted into a tendency over chase laborers working time in order to get higher wages. In addition, the company also set up at the job worker is not allowed to rest because here the flow of production activities continuing, so workers should always be ready in position. When one

ISBN 978-602-294-020-3

tion negligent in handling his duties, re will be a bottleneck that could hurt the mpany.

ed on the recommended weight for a rker, judging by the state of its workforce re is a provision that is recommended as Table 1.

le 1. Expense Appointment According the state of labor

ng frequency	Adult		Young	
	Man (Kg)	Woman (Kg)	Man (Kg)	Woman (Kg)
a while	40 kg	15 kg	15 kg	10-12 kg
s	15-18 kg	10	10-15 kg	6-9 kg

mur, 1989 in Soleman, 2011.

kers on the first processing entirely hin the adult age category and perform work continuously. Under the terms of recommended weight, the workers uld carry a weight of 15-18 kg, whereas ality the average weight of the blanket ied by workers ranged between 30-35 kg. rthermore, the processing of the second duction line activities related to quality rance and product standards. The duction line consists of workstations that re a human operator in analyzing of the ults of production activities such as:

Testing of raw material

Operators perform the analysis of the rcentage of pure rubber content. Plans alled testers or appraiser do an sessment on percentage of work done ually or by looking at the structure and ture of rubber. Percentage of pure ber assessment process is a very portant function in the trade of rubber w materials, the error rate (errors) in e assessment of the minimum required, reby permissible tolerance is +0.5%. erators must be careful in assessing e cause of profit and loss in the rchase of raw materials also depend on e appraiser's ability to analyze.

Control panel

In this workstation operators task is to regulate cooking temperature of the blanket. Prior to cooking, the operator must know how high the water content remaining on the blanket and adjust the temperature and length of cooking time accordingly. If the cooking is not in accordance with the temperature and time, it will generate wasted crumb rubber due to the poor quality. It becomes too dry and reduce quality standards. One of the other problems that cause mental burden here is the condition of the appliance. The control panel machine is getting old.

3. Contaminant/inspection
   Each product is produced with standard quality required; one of the standard is that the product should be free of contaminants objects. Operators working in this workstation do the inspection by seeing if there are other objects carried in the crumb rubber pads that are ready to be packed. This work was done in a standing position with the allocated conveyor carrying the crumb rubber pads. Because the use of the conveyor, then the work must be done quickly and accurately. The operators often experience psychological distress in wondering wheter they made a mistake, such as dirt in the product. If the mistake is found out in the shipping area, all products in the same containner have to be inspected again entirely. It will cost the company more.

It is important for companies to know the level of physiological workload of workers and the psychological burden experienced by the operator, so that the productivity of each production line can be maintained over an increase in the quality of production. The main concern in the production of quality rubber Bangkinang PT P & P is the speed and quality of production activity by a factor of accuracy in determining the temperature and inspection before final packaging (storage).

ISBN 978-602-294-020-3

b. Objectives

The objectives of this study are as follows:

1. To determine the level of physiological workload processing production workers received I.
2. To determine the level of psychological workload experienced production operators processing II.
3. To find the workload measurement and provide recommendations for the better production process.

B. LITERATURE STUDY

a. Definition of work

Work is anything that is done by man to life as a human being. Human work is mentally and physically each has different intensity. The level of intensity is too high allowing the use of excessive energy, intensity is too low otherwise allow feeling bored and tired. Physical work is a job that requires the function of muscle performance and spending a lot of energy. Physical work will make a difference to the oxygen consumption, heart rate, body temperature, and chemical compounds in the body. The psychological workload is closely related to capacity analysis capabilities, precision, spirit or mind of a person.

b. The concept of balance in ergonomic

Ergonomics is a science, art and technology that seeks to harmonize the tools, methods and work environment on the ability, skill and human limitations, so that people can work optimally without the bad influence of his work. From the standpoint of ergonomics, the demands of the task with a working capacity must always be in balance so that the line of work that high performance is achieved. In other words, the demands of the task should not be too low (underload) and also should not be too excessive (overload). Because both the underload and overload of a workers will cause stress (Tarwaka, 2004).

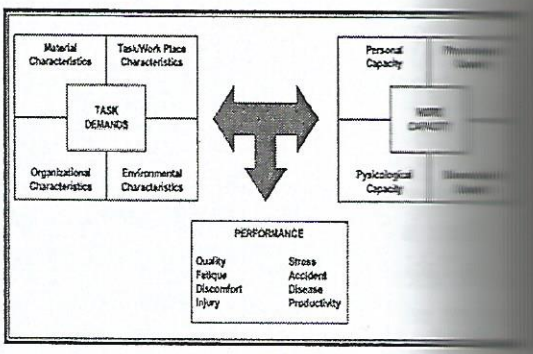

Figure 1. The concept of balance in ergonomic

c. Workload

The work has its own load and p... either directly or indirectly. It ... influenced by internal and external ... in the work environment. Workload ... experienced physical workload, for ... associated with manual material ... As for the workers associated ... analysis, concentration, and ... suffered mental workload / psych... From the standpoint of ergonom... workload is received by the pers... appropriate or balanced both in ... abilities, as well as cognitive, as ... limitations of human beings who ... load. Ability to work a labor ... one to another and depends on the ... skills, physical fitness, age, and bod... the workers concerned.

d. Physiological workload

Physical work is work that requires ... energy of human muscle as a ... energy. Physical work is also ... "manual operation" which means ... performance of work will depend ... on humans that serve as a source of ... (power) or controller of work. ... work can also be associated with ... work or manual labor because ... activities require strong human ... effort. In the physical labor is a major ... of energy consumption be... determinants heavy / light job. ... speaking, human activities can be ... into physical work and mental ... separation cannot be done perfectly ...

ISBN 978-602-294-020-3

e to one another. Physical work will lt in changes in the function of the s, which can be detected through rwaka, 2004):

1. Oxygen consumption
2. Heartbeat
3. Air circulation in lung
4. bodytemperature
5. Concentration of lactic acid in the blood
6. Chemical composition in the blood and urine
7. Evaporation rate

ical work will expend energy is closely ted to energy consumption. Energy mption in the working time is usually mined in an indirect way, ie by suring heart rate and oxygen mption (Tarwaka, 2004).

ect method

ect measurement method is by easuring the energy expended (energy enditure) by oxygen intake during rk. Increasingly heavy workload will e more and more energy is needed for sumption.

2. Based Workload Category bolism, respiration, body temperature rt rate

category	Age (year)			
	<30	30-39	40-49	>50
ght	0,5-1,0	11,0-20	37,5	75-100
dium	1,0-1,5	20-30	37,5-38,0	100-125
avy	1,5-2,0	31-43	38,0-38,5	125-150
ry heavy	2,0-2,5	43-56	38,5-39,0	150-175
emely heavier	2,5-4,0	60-100	>39	>175

odo, 2008

3. Maximum oxygen consumption

egory	Age (year)			
	<30	30-39	40-49	>50
ry bad	<25	<25	<25	-
ad	25-33,7	25-30,1	25-26,4	25
ency	33,8-42,5	30,2-39,1	26,5-35,4	25,0-33,7
od	42,6-51,5	39,2-48	35,5-45,5	33,8-43,0
ter	>51,6	>48,1	>45,1	>43,1

odo, 2008

In determining the energy consumption is usually used a form of energy relationship with heart rate is a quadratic regression equation as follows (Manuaba, 1992):

$$E = 1{,}80411 - 0{,}0229038\,X + 4{,}71733 \times 10^{-4} X^2$$

where :
E = Energy (Kcal/minute)
X = heart beat speed (beat/minute)

b. Indirect method

Indirect assessment method is to count the pulse for work. Measurement of heart rate during work is a method for assessing cardiovasculair strains with 10 pulse method, this method can be calculated with the pulse of the work as follows (Kilbon, 1992 in Sundari 2011):
Pulse = 10 beat/calculation time x 60

Sensitivity to changes in the loading pulse received by the body high enough. Energy consumption alone is not sufficient to estimate the physical workload. Physical workload is not only determined by the number of kJ consumed, but also determined by the amount of muscle involved and received a static load and thermal stress of the work environment that can increase heart rate.
Increased pulse has a very important role in increasing cardiac output from rest to maximum employment. To determine the workload classification is based on the increase in pulse work compared with the maximum pulse because of the burden of cardiovascular (cardiovascular load =% CVL), can be calculated by the following formula (Widodo, 2008):

$$\%\,CVL = \frac{100\,(Denyut\ nadi\ kerja - Denyut\ nadi\ istirahat)}{Denyut\ nadi\ maksimum - Denyut\ nadi\ istirahat}$$

Where is the maximum pulse rate (220-age) for males and (200-age) for women. From the calculation of% CVL will then be

ISBN 978-602-294-020-3

compared with a predetermined classification as follows (Widodo, 2008):

a. <30% = no fatigue
b. 30<60% = necessary repairs
c. 60<80% = working in a short time
d. 80<100% = required immediate action
e. >100% = not allowed to activity

Under these conditions, the caloric needs can be used as an indicator to determine the severity of the workload (Kep. Men. Tenaga Kerja-51/Men/I999) :

1. Light workload :100-200 kcal/h
2. Medium workload : > 200-350 kcal/h
3. Heavy workload : > 350-500 kcal/h

e. Psychological workload

Work is work involving mental thought processes of our brain. The work resulted in mental fatigue when working under the old conditions, not caused by direct physical activity but due to our brains work. Every mental activity will always involve an element of perception, interpretation and mental processes of an information received by the sensory organs to take a decision or process of remembering information that is stored. The sources of stress in the work environment that can lead to psychological stress, physical work space which is not good, just too heavy workload, work tempo is too fast, too simple job, role conflict, relations with superiors and co-workers as well as the unfavorable organizational climate less pleasant. Measurement of subjective psychological workload can be done with the subjective method, namely the NASA-TLX (National Aeronautical and Space Administration Task Load Index).
Mental load has a fairly high correlation of the errors made (error). The higher the mental load imposed the higher the error that caused or may be said that given the lower performance if the load exceeds the capacity. This research used the NASA-TLX form of a questionnaire developed by the emergence of the need for subjective measurement easier but more sensitive to the measurement of workload. Developed by the emergence of subjective measurement needs consisting of nine factors (task difficulty, time pressure, of activity, physical effort, mental performance, frustration, stress and Of the nine factors are further into 6 (Simanjuntak, 2010):

1. *Mental demand*
2. *Physical demand*
3. *Temporal (time) demand*
4. *Performance*
5. *Effort*
6. *Frustration*

The following indicators and comparisons in Table 4 and

Table 4. Indicators NASA-TLX

Scale	Questions
Mental Deman (MD)	According to you how much mental activity is needed for this job?
	such as: Concentration in viewing, searching, observing
Physical Demand (PD)	According to you how much physical activity is needed for this job?
	such as: Event pushing, pulling, twisting, lifting
Temporal Demand (TD)	According to you how much pressure did you feel due to the time available for this work?
	such as: Slowly, relaxed, fast
Performance (OP)	How much do you think your success rate in doing this job?
	such as: related to job satisfaction and the results obtained
Frustration Demand (FR)	According to you how much anxiety, feelings of pressure, and the stress that you feel for this job?
	such as: Convenience and the level of disruption
Effort (EF)	According to you how much effort (mental and physical) that is issued to do this job?
	such as: the complexity of easy or difficult

Table 5. NASA-TLX paired indica

No.	1	2
1	PD	MD
2	TD	MD
3	OP	MD
4	FR	MD
5	EF	MD
6	TD	PD
7	OP	PD
8	FR	PD
9	EF	PD
10	TD	OP
11	TD	FR
12	TD	EF
13	OP	FR
14	OP	EF
15	EF	FR

To get a score of NASA TLX load, weight and rating for each in multiplied, then summed and divide total number of pairwise comparis

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$$\text{...} = \frac{\Sigma(\text{bobot x rating})}{15}$$

$$\text{...-rata } WWL = \frac{WWL}{15}$$

...er obtained the average psychological ...kload of operators can be categorized ...ed on the average value of the Weighted ...kload (WWL). Workload categories ...played in Table 6.

...le 6. Workload Categories

No	Range (average WWL)	Category
1	0 -- 9	Low
2	10 -- 29	Medium
3	30 -- 49	somewhat higher
4	50 -- 79	High
5	50 -- 100	Very High

...OLLECTING AND DATA ...ROCESSING

...ecapitulation of physiological data

...re is the data that is needed in the study ...physiological workload to 6 workers at ...processing 1 in PT P & P Bangkinang.

...le 7. Pulse of workers

...borers	Work station	10 heart beat/pulse Before working (seconds)	10 heart beat/pulse While working (seconds)
...	Cutting *Blanket*	7,94	4,9
...	Press	8,3	7,8
...	Press	8,5	7,2
...	*Breaker*	7,8	5,6
...	Pull	8,2	5,4
...	Pull	8,41	5,7

...ecapitulation of the NASA-TLX ...estionnaire data

...following summary data from the ...SA-TLX questionnaire on 5 operators ...ssing II

...le 8. Summary data from the NASA-...LX questionnaire

...	work station	MD	PD	TD	OP	FR	EF
...	*Control Panel*	75	50	50	75	80	60
...	*Control Panel*	75	80	80	80	75	60
...	Kontaminan/Inspeksi	95	50	80	80	90	50
...	Kontaminan/Inspeksi	80	50	80	70	60	90
...	Pengetesan bahan baku	80	60	50	90	75	70

Table 9. comparison indicator of NASA-TLX summary

Responden	Rafta Rizal		Andresius		Nurma		Suharmen		Asmuni	
workstation	Control panel		Control panel		Kontaminan		Kontaminan		Testing	
1	PD	MD	PD	MD	PD	MD	PD	MD	PD	MD
2	TD	MD	TD	MD	TD	MD	TD	MD	TD	MD
3	OP	MD	OP	MD	OP	MD	OP	MD	OP	MD
4	FR	MD	FR	MD	FR	MD	FR	MD	FR	MD
5	EF	MD	EF	MD	EF	MD	EF	MD	EF	MD
6	TD	PD	TD	PD	TD	PD	TD	PD	TD	PD
7	OP	PD	OP	PD	OP	PD	OP	PD	OP	PD
8	FR	PD	FR	PD	FR	PD	FR	PD	FR	PD
9	EF	PD	EF	PD	EF	PD	EF	PD	EF	PD
10	TD	OP	TD	OP	TD	OP	TD	OP	TD	OP
11	TD	FR	TD	FR	TD	FR	TD	FR	TD	FR
12	TD	EF	TD	EF	TD	EF	TD	EF	TD	EF
13	OP	FR	OP	FR	OP	FR	OP	FR	OP	FR
14	OP	EF	OP	EF	OP	EF	OP	EF	OP	EF
15	EF	FR	EF	FR	EF	FR	EF	FR	EF	FR

c. *Data Processing*

Processing is done to obtain physiological and psychological workload received by workers and operators in PT P & P Bangkinang.

a. *Energy consumption*

Calculation of energy consumption is performed to determine the amount of energy released by each operator on the production of crumb rubber in PT P & P Bangkinang.

Table 10. Energy consumption at rest

No.	Laborers	Work station	Recapitulation Energy Levels At Rest	
			Number of Pulse / Minute	Energy Level (kcal/min)
1	Rahmat	Cutting *Blanket*	75,5668	0,0113
2	Imah	Press	72,2892	0,0092
3	Adisal	Press	70,5882	0,0082
4	Damirsan	*Breaker*	76,9231	0,0122
5	Muzarman	Pull	73,1707	0,0097
6	Yatno	Pull	71,3436	0,0086

Table 11. Energy consumption at work

No.	Laborers	Work station	Recapitulation Energy Levels At Work	
			Number of Pulse / Minute	Energy Level (kcal/min)
1	Rahmat	Cutting *Blanket*	122,4490	0,0628
2	Imah	Press	76,9231	0,0122
3	Adisal	Press	83,3333	0,0171
4	Damirsan	*Breaker*	107,1429	0,0423
5	Muzarman	Pull	111,1111	0,0473
6	Yatno	Pull	105,2632	0,0399

ISBN 978-602-294-020-3

Table 12. Total consumption of energy

No.	Laborers	Work station	Workload Energy (kcal/h)		Energy consumption (kcal/h)
			Energy While in Rest	Energi While Working	
1	Rahmat	Cutting *Blanket*	42,575	237,202	194,627
2	Imah	Press	37,496	49,737	12,241
3	Adisal	Press	34,475	71,861	37,387
4	Damirsan	*Breaker*	51,200	177,463	126,263
5	Muzarman	Pull	32,091	156,117	124,026
6	Yatno	Pull	31,091	143,755	112,664

Example :

Energy consumption (KE) = E_k - E_i

=237,202 – 42,575 = 194,627 kcal/h

Cardiovascular load (%CVL) is used to determine the classification Based on the increase in workload between resting pulse rate (DNI) with a working pulse (DNK), which in comparison with the maximum pulse (DNmax). The maximum pulse value obtained by subtracting a constant with age operator, example (220-age) for males and (200-age) for women. % of CVL calculation is then compared with a predetermined classification.

Table 13. load of %CVL

No.	Laborers	Work station	Number of pulse/Minute		%CVL
			rest pulse	work pulse	
1	Rahmat	Cutting *Blanket*	75,567	122,449	48,62
2	Imah	Press	72,289	76,923	4,60
3	Adisal	Press	70,588	83,333	11,65
4	Damirsan	*Breaker*	76,923	107,143	32,12
5	Muzarman	Pull	73,171	111,111	39,59
6	Yatno	Pull	71,344	105,263	33,37

Calculation of psychological workload with NASA-TLX method is obtained by calculating the average Weighted Workload (WWL) of each operator. WWL value obtained by multiplying the weight rating and the NASA-TLX questionnaire that was completed by each respondent. The weight values obtained from pairwise comparisons in the questionnaire.

Table 14. workload category b… %CVL

No.	Nama Responden	Stasiun Kerja	Nilai WWL
1	Rafla Rizal	*Control Panel*	68,33
2	Andresius	*Control Panel*	77,33
3	Nurma	Kontaminan/Inspeksi	80,33
4	Suharmen	Kontaminan/Inspeksi	74,00
5	Asmani	Pengetesan bahan baku	72,33

b. Energy consumption

The average type of work perfor… first processing line (breaker, cut… press) which are at moderate light… with a range of energy expenditure … is 100-200 kcal / hour. It is obtained … reducing the energy when working … energy before doing the work. Highest … energy consumption is felt by the … cut blanket (Grace) with energy expe… of 194.627 kcal / h. The energy … nearly the kind of hard work … operator may exceed the limits. … as breach of employment may also … the worker does not compensate … activities with the rest.

c. Analysis of %CVL

Determination of the energy … CVL known by changes in pulse … at work, and the maximum pulse … sex. CVL value% sequentially … highest to the lowest are cut … (48.62), workers pull 1 (39.59), … pull 2 (33.37), labor breaker … milling workers (11.65), and … milling 2 (4.60).

Based on the value of% CVL … in the range of values <30% not … fatigue, but that was> 30% is … repair the system work. In general … workers experiencing job … work should be done. This can be … the value of% CVL experienced … blanket (Rahmat) is too high … other workers. This means the … distribution of the work is not … cutting workstations, and working … is also not good because it is … stand. Repairs may be done by …

ISBN 978-602-294-020-3

labor activity by increasing the number of workers on the cutting blanket or add pieces of work stations that blanket the weight distribution of the work is not centered on one side only.

d. Analysis of NASA-TLX

Generally, workers are under pressure at the level of anxiety about how the product is produced, this includes a frustation demand indicator (FR), because they expect that the production of high quality so that the goal can be achieved, because if there is an error and inaccuracy, it will cause a huge loss for the company. As for some of the causes of high perceived mental burden on the type of treatment works II (contaminants, control panel, testing) is influenced by some of the factors, such as high risk work to guarantee the quality of the product, as well as the responsibilities of the job that must be maintained.

CONCLUSION

a. Conclusion

Calculation of physiological load on the production line processing I (breaker, press, pull, cuts) shows a system repair work needs to be done to increase the work station to work with the old frequency and high production weights, because the type of work on a production line processing including job I moderate light, which is approaching the workload is quite heavy. Based on energy consumption, the heaviest workload experienced by workers cutting energy consumption blanket with 194.62 kcal / h and% CVL = 48.62%, the value of the how to do repair work system, by changing the way of working, as well as the designing tool.

On the production line II (testing, contaminants, control panel) the mental load experienced by the operator is at a high level. This is because the type of work here prioritizes accuracy and requires the operator to avoid mistakes to a minimum. Mental burden is generally on the biggest frustation indicator Demand (FR) which causes the operator to feel anxious about the results and the pressure due to fear of making mistakes. Indicators frustation Demand (FR) can be affected due to the convenience and level of disturbance while doing the job.

3. Need improvements such as the addition of a working system operator or the distribution of load is more evenly job with better rules on working hours on the production line I, and increased motivation of workers, the number of operators as well as the adjustment of the working conditions on the processing line II.

b. Sugesstions

1. For further research can design a tool that can reduce the physiological workload in processing line 1.
2. Allocation order for the company to add the number of operators who work on the second processing work station so that accuracy can be maintained in the work.
3. Conduct periodic evaluation of job satisfaction that can be known complaints and obstacles experienced by workers in their duties.

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