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Rest Time Analysis Based on Operator's Workload Using a Physiological Measures at PT. Amanah Insanillahia

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Abstract

PT. Amanah Insanillahia is a manufacturing company that produces bottled drinking water (AMDK). The high demand for drinking water production at PT Amanah Insanillahia requires workers to do their work as much as possible in order to achieve the targets desired by the company. In addition to the targets to be achieved, the company must also pay attention to the operator's workload. Workload related to physical fatigue will reduce performance and increase errors at work. This study aims to determine the operator's rest time using a physiological approach. The method used is quantitative with data collection carried out directly. The object of research is the population of employees in the 220 ml packaging station. Heart rate measurement is done by utilizing the 10-beat method. The results show that the value of K < S, the energy expended during work is less than the standard value of energy expended (men = 5 kcal/min, women = 4 kcal/min), then Rt = 0. This means that the rest time provided by the company is adequate, so there is no need for additional resting time at the 220 ml packaging station.

Keywords: rest time, workload, heart rate, 10-beat, physiological approach

INTRODUCTION

PT. Amanah Insanillahia is a manufacturing company that produces bottled drinking water. The high demand for drinking water production at PT. Amanah Insanillahia requires workers to do their work as much as possible in order to achieve the targets desired by the company. In addition to the targets to be achieved, the company must also pay attention to the operator's workload.

Physical workload requires more energy than mental work (Irfan, 2022). Workload related to physical fatigue will reduce performance and increase work errors. In general, workers will perform well and get good results when they are in good working conditions with not excessive fatigue. Workload that is too high can result in burnout for employees. Workload is an accumulation of work that must be done by a worker in an organization and is the result of multiplying work time and work volume (Darmawan and Djaelani, 2021). The interaction between task demands and individual skills, behavior and perceptions is a determinant of workload. External factors also play an important role in the condition of a person's workload such as organizational, environmental, psychological factors, and so on. A worker who has the ability under the demands of the task will have a high workload so that the impact on the physical condition that feels tired. There are three categories of workloads, namely workloads that are too low, workloads that are too high and standard workloads. All organs, brain, muscles are involved in work activities so that an increase in work activity is directly proportional to an increase in workload (Davis et al., 2009).

Therefore, this is important for a company to pay attention to because it will affect the sustainability of the company, including whether production targets are achieved and whether the quality of the products produced is good or not. Based on these conditions, research was conducted on the physiological workload of operators to find out the best action that can be taken by the company.

LITERATURE REVIEW

Workload

“Workload is a term that represents the cost of achieving mission requirements for human operators” (Hart, 2006). It has long been recognized that individual performance is greatly influenced by workload. The operator's ability to complete tasks is influenced by the workload which consists of a group of elements such as work environment, motivation, cooperation, and other factors. So, when someone experiences a lack of time in completing their tasks, or when the difficulty or frequency of tasks exceeds one's abilities; this will cause an increase in workload (Ntuen, 1999).

Workload Assessment with Indirect Method

The indirect assessment method is to count the heart rate during work. Measurement of heart rate while working is a method for assessing cardiovascular strain; One popular method that is often used is the 10 beats method whereby this method can calculate the heart rate as follows:

$$\text{Heart Rate (Beat/Minute)} = \frac{\mathbf{10\ Beat}}{\mathbf{Calculation\ Time}}\ \boldsymbol{x\ 60} \quad (1)$$

This 10-beat method was promoted by Brooke et al. (1970) who proposed "that exercise heart rate should be defined as the time taken for 10 beats of the heart measured from the stable wave pattern of the normal electrocardiogram and converted into beats/minute". Furthermore, to determine the classification of workload based on an increase in working heart rate compared to the maximum heart rate due to cardiovascular load (cardiovascular load = % CVL) can be calculated using the following formula:

$$\%\ CVL = \frac{100\ x\ (Working\ heart\ rate - Resting\ heart\ rate)}{Maximum\ heart\ rate - Resting\ heart\ rate}\ x\ 100 \quad (2)$$

Where the maximum heart rate is $220 - age$ for men and $200 - age$ for women (3)

From the results of the calculation of % CVL, it is then compared with the classification that has been determined in table 1 as follows:

Table 1. Classification of Light Weight Working Load Based on % CVL

% CVL	% CVL Classification
<30%	No Fatigue Occurs
30% - 60%	Repair Needed
60% - 80%	Work in no time
80% - 100%	Urgent action is required
>100%	No activities allowed

Determination of Rest Time Using a Physiological Approach

In determining energy consumption, a relationship between energy and heart rate is usually used, namely a quadratic regression equation as follows:

$$E = 1.80411 - 0.0229038\ (x) + 4.71733 * 10^{-4}\ (x)^2 \quad (4)$$

Information:
E = Energy (Kcal/minute)
X = heart rate/pulse rate (beats/minute)

After doing the above calculations, we can calculate energy consumption using the equation:

$$KE = E_t - E_i \quad (5)$$

Information:
KE = Energy consumption (kilocalories/minute)
E_t = Energy expenditure at a certain time of work (kilocalories/minute)
E_i = Expenditure of energy before work

Furthermore, energy consumption is converted into rest time requirements using the Murrel equation (Kakerissa, 2019) as follows:

$$Rt = 0 \text{ for } K<S \quad (6)$$

$$Rt = \frac{K/S1xT(K.S)/xBM}{2} \text{ for } S<K<2S \quad (7)$$

$$Rt = \frac{T(K.S)}{K.BM}\ x\ 1{,}11 \text{ for } K>2S \quad (8)$$

Information:
Rt = rest time
K = energy expended during work
S = standard energy expended (men = 5 kcal/minute, women = 4 kcal/minute)
BM = basal metabolism (men = 1.7 kcal/minute, women = 1.4 kcal/minute)
T = length of work (minutes).

METHODS

This research is a type of quantitative research that emphasizes objective phenomena and is processed based on data in the form of numbers. The research design is maximized by using statistical processes, structures, and controlled experiments. The study population was all workers in the 220 ml packing section, totaling seven people. The data taken is the result of direct observation.

This research was conducted through several stages. First, researchers conducted a literature study related to fatigue and physical workload. Furthermore, field studies were conducted to determine the object of research. Then, problem identification is carried out. In the next stage, the researcher collected data directly for further data processing using the theory of workload assessment using the indirect method. The results of data processing are then analyzed to get the conclusion.

RESULT AND DISCUSSION

Heart Rate Calculation

Data on the heart rate of workers in the 220 ml packaging work group can be seen in Table 2. Working heart rate was obtained by using the 10-beat method.

Tabel 2. Heart Rate Calculation of the 220 ml packaging work group

No	Name	Age	Weight	Resting HR/ minute	Working HR/ minute		
					08.30	09.30	10.30
1	Dia	35	45	63.6	95.6	90.6	87.3
2	Suci	24	50	66.9	92.6	98.3	101.2
3	Bayu	25	67	71.9	100.9	105.2	109
4	Rintol	21	48	77.4	107.4	110.6	116.9
5	Iges	23	49	71.2	101.2	100.5	109.8
6	Daffa	21	45	75.2	105.2	108.2	110.6
7	Ajo	24	46	73.8	103.8	105.2	108.2

Table 3. Heart Rate Recapitulation of the 220 ml packaging work group

Name	Age	Weight	Resting HR/ minute	Working HR/ minute	Maximum HR/minute
Dia	35	45	63.6	91.17	165
Suci	24	50	66.9	97.37	176
Bayu	25	67	71.9	105.03	195
Rintol	21	48	77.4	111.63	199
Iges	23	49	71.2	103.83	197
Daffa	21	45	75.2	108.00	199
Ajo	24	46	73.8	105.73	196

Defines %CVL

From table 3 data, the %CVL calculation is obtained as follows:

Table 4. %CVL Recapitulation of the 220 ml packaging work group

Name	%CVL	Information
Dia	27	No Fatigue Occurs
Suci	28	No Fatigue Occurs
Bayu	27	No Fatigue Occurs
Rintol	28	No Fatigue Occurs
Iges	26	No Fatigue Occurs
Daffa	26	No Fatigue Occurs

Ajo	26	No Fatigue Occurs

Calculation of rest time for the 220 ml packaging work group

Using the energy consumption formula, below is the recapitulation of rest time for 220 ml packaging work group:

Table 5. Rest Time Recapitulation of the 220 ml packaging work group

Name	Et	Ei	KE
Dia	3.64	2.26	1.38
Suci	4.05	2.38	1.66
Bayu	4.60	2.60	2.01
Rintol	5.13	2.86	2.27
Iges	4.51	2.56	1.95
Daffa	4.83	2.75	2.08
Ajo	4.66	2.68	1.97

Because the value of K < S, the energy expended during work is less than the standard value of energy expended (men = 5 kcal/min, women = 4 kcal/min), then Rt = 0. This means that the rest time for now is adequate, so there is no need for additional resting time at the 220 ml packaging station.

CONCLUSION

Based on a physiological approach to determining rest time by calculating the energy consumption needed during work which is converted into rest time requirements; stated that there was no need for rest time during the work process at the 220 ml packing workstation (Rt = 0). This means that the break provided by the company for 60 minutes is sufficient.

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