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Analysis of Boiler Operation Workload in Salted Fish Small Medium Enterprises (SMEs)

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Abstract. A person's physical condition at work is crucial to the production output. This can be influenced by operator fatigue factor based on operator's calorie requirement while working, since the amount of energy that comes out is greater than the incoming energy at work. The operators working on fish boiling stations are 2 operators and with 2-3 hours working time per day. Thus, to determine the fatigue factor of the operator is to know the pulse operator to determine the number of calories needed by the operator while working. Then the determination of the classification of workload based on the increase in the maximum pulse due to the burden (cardiovascular load = CVL) in every activity undertaken by the worker needs to be known. It is expected that workers can do their work to the maximum in a long time. The method of Cardiovascular Load (CVL) is a calculation to determine the classification of workload based on the calculation of the working pulse rate difference with the resting pulse compared to the difference between the maximum pulse with resting pulse.

Keywords: Small Medium Enterprises,Entrepereneur, Production Output.

1. Introduction

The Heart rate variability and subjective workload size are widely used to determine the workload [1]. If the pulse is monitored during rest, work and recovery then recovery time to rest increases in line with the workload. In extreme circumstances, the worker does not have sufficient rest time resulting in chronic fatigue [2].According to [3] explains that one approach to knowing the weight or lightness of workload is to calculate the work pulse, oxygen consumption, pulmonary ventilation capacity and core body temperature. Measurement of heart rate during work is a method for assessing Cardiovasculair Strain. One of the tools used to calculate the pulse is telemetryusing Electro Cardio Graphi (ECG). If the equipment is not available, it can be recorded manually using a stopwatch using the 10 pulse method. Increased pulse rate plays an important role in increasing Cardic Output from rest until maximum work is defined as Heart Rate Reserve (HR Reserve). The classification of workloads based on an increase in the work rate compared with the maximum pulse due to cardiovascular load.

2. Method

The research study uses primary data. Primary Data, as data obtained directly by researchers through in-depth and semi structured interviews, observations, photographs and documents with key informants. To obtain this data using an instrument in the form of interview guidelines.Respondents are businessmen and entrepreneur SME in Salted Fish Small in North Sumatera. This qualitative research process involves important efforts, such as asking questions and procedures to collect specific data, analyzing data inductively from themes that are specific to common themes, and interpreting the meaning of data [4], [5], [6], [7] [8], [9], [10]&[11]. This type of research is descriptive which describes the reality of the object of research and gives meaning to the object under study. Even the opinion of [states that this study also reveals and understands something behind the phenomenon just known. The data in this study were obtained by measuring the operator pulse before and after work in boiling stations with activities in SME Salted Fish. Boiling activity can be seen in the picture below.

The data collection procedure activity activities are as follows:
1. Operator measured the pulse of its rest (DNI).
2. The operator does the boiling work
3. The operator who has performed the activity of filling for 2 hours directly measured the working pulse (DNK) for 60 seconds.

Data collection is very concerned about the degree of trust (credibility), transferability (dependability) and dependability (conformability).The validity of the data in the study requires a standard to see the degree of trust or the truth of the research results to get the data collected can be accounted for. In describing the results of the research applying the truth in collecting facts, data and information in the field. After the description process in this research is complete, then the researcher can conclude the data in accordance with the formulation of the problem that has been formulated previously.

3. Results and Discussions
3.1. Data collection

Measurement of pulse rate is done to 2 workers by taking DNI and DNK data after doing their work activity on the boiling station. Workers on the boiling process do their work within 2 hours.

The pulse data of each operator served in the following Table
1. Table 1. Operator Pulse Rate Data

Hari	Shift	Nama	Umur	Jenis Kelamin	DNI	DNK
1	A	Rizal	26	Pria	63	105
	B	Andri	23	Pria	60	102
2	A	Rizal	26	Pria	64	108
	B	Andri	23	Pria	62	105
3	A	Rizal	26	Pria	64	108
	B	Andri	23	Pria	62	106
4	A	Rizal	26	Pria	65	110
	B	Andri	23	Pria	64	107
5	A	Rizal	26	Pria	63	107
	B	Andri	23	Pria	61	104
6	A	Rizal	26	Pria	64	108
	B	Andri	23	Pria	62	105
7	A	Rizal	26	Pria	65	110
	B	Andri	23	Pria	63	106

From the Table 1 observation data of pulse performed for 7 days above then taken the average value of the pulse seen in Table 2.

Table 2. Average Operator Pulse Rate

No.	Name	Age	Gender	DNI	DNK
1	Rizal	26	Men	64	108
2	Andri	23	Men	62	105

3.2. Indirect Assessment Method

The indirect assessment method is an assessment method by counting the operator's pulse at rest and shortly after the operator works as the operator's pulse.The method of Cardiovascular Load (CVL) is a calculation to determine the classification of workload based on the calculation of the working pulse rate difference with the resting pulse compared with the difference between the maximum pulse with the resting pulse. The% CVL equation is shown by the following formula:
The maximum pulse rate is as follows:

$$\% \, CVL = \frac{Denyut \, Nadi \, Kerja - Denyut \, Nadi \, Istirahat}{Denyut \, Nadi_{maks} - Denyut \, Nadi \, Istirahat} \times 100\%$$

Male: 220 - age
Female: 200 - age

Table 3. Maximum Pulse Operators

Names	DN$_{kerja}$	DN$_{istirahat}$	Usia	DN$_{maks}$	%CVL	Classification of Workload
Rizal	108	64	26	194	33,85	Required repairs
Andri	105	62	23	197	31,85	Required repairs

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From the calculation of CVL% obtained then it can be concluded based on the classification of workload that has been set, as follows:

Table 4. Classification of Light Weight Workload Based on% CVL

% CVL	Classification% CVL
< 30 %	No fatigue
30 % - 60 %	Required repairs
60 % - 80 %	Work in no time
80 % - 100 %	Urgent action is required
> 100 %	No activity allowed

3.3. Cardiovascularload Percentage Determination (% CVL)

The calculation of the workload of the weighing operator by the% CVL method of the data taken at the time of the research requires some calculation steps. The first step is to calculate the Maximum Pulse (DNMax) of each operator by using the formula (220 "life) for men and (200" ages) for women.

Maximum pulse for operator 1 (Rizal):
Male gender
Age: 26 years
Then the calculation is as follows:
Male = 220 age = 220 26 = 194
Maximum pulse for operator 2 (Andri):
Male gender
Age: 23 years old
Then the calculation is as follows:
Male = 220 age = 220 - 23 = 197
Calculation of % CVL for each operator at boiling station can be seen below:

Operator 1: Rizal

$\% \ CVL = \frac{108 - 64}{194 - 64} \ x \ 100\% = \frac{44}{130} \ x \ 100\%$ = 33.85%

Operator 2: Andri

$\% \ CVL = \frac{105 - 62}{197 - 62} \ x \ 100\% = \frac{43}{135} \ x \ 100\%$ = 31.85%

Recapitulation of CVL% calculation for each operator in boiling station served in Table 5 following.

Table 5. Recapitulation of Value Calculation CVL Boiling Operator

Nama	DN$_{kerja}$	Energy Expenditure (Cal/min)	Heart Rate during Work (Beats/min)	Kebutuhan energi (Kal/menit)	Kategori Beban Kerja
Rizal	108	5 – 7,5	100 – 125	5,8	Sedang
Andri	105	5 – 7,5	100 – 125	5,5	Sedang

3.4. Energy Expenditure Calculations

Energy expenditure calculations are performed by interpolation which has been assumed before that the operator with the amount of 100 heartbeats per minute requires an energy expenditure of 5 calories per minute.

The following is the calculation of energy needs of operators in boiling stations, namely:
1. Operator 1: Rizal =
20 = - 125 +
25.x X = 5.8
Energy expenditure needs for Operator 1: Rizal is 5.8 calories/minute.
2. Operator 2: Andri=
12.5 = - 125 + 25.x

X = 5.5

Energy expenditure needs for Operator 2: Andri is 5.5 calories/minute.

Recapitulation of calculation result of expenditure energy requirement of operator in boiling station can be seen in Table 5. Below

3.5. Direct Assessment Method

The method of direct assessment is to calculate the energy consumption of the operator. In the determination of energy consumption is usually used a form of energy relationship with the heart rate velocity is a quadratic regression equation as follows

$$e = 1.80411 + 0.0229038(X) + 4.71711.10\text{-}4 \ (X) \ 2$$

Where:

E = Energy (Kcal / min)

X = Working Pulse (pulse per minute)

Classification of workload based on energy consumption value (Y) with unit conversion in Kkal / Jam, which is as follows:

1. Light work load, for 100 - 200 Kcal / hour
2. Medium work load, for 201 - 350 Kcal / hour
3. Heavy work load, above 350 Kcal / hour

The calculation of energy consumption in each weighing operator can be seen below:

1. Operator 1: Rizal

Working pulse (X) = 105 dpm

Then the value of energy consumption of Operator 1 is:

E = 1.80411 0.0229038 (108) + 4.71711.10-4 (108) 2

E = 1.80411 2.47361 + 5,502037

E = 4,832536704 Kcal / min = 289,9522022 Kcal / hour

2. Operator 2: Andri Working

pulse (X) = 102 dpm

Then the value of energy consumption of Operator 1 isE = 1.80411 0.0229038 (105) + 4.71711.10-4 (105) 2

E = 1.80411 - 2.404899 + 5,200614

E = 4,599824775 Kcal / min = 275,9894865 Kcal / hour

Recapitulation of calculation of energy consumption value of boiling operator in the following Table 6.

Table 6. Recapitulation of Energy Consumption Value of Boiling Operator

Operator	DNK (dpm)	E		Workload Category
		(Kkal/minute)	(Kkal/hour)	
1	108	4,832	289,952	Medium
2	105	4,599	275,989	Medium

4.Conclusions

1. Based on the results of processing the percentage of cardiovascular load obtained that the second category included required improvement.
2. Based on the results of processing energy consumption operator obtained that both operators are classified.
3. Category of workload on both operators the workload received by the operator is moderate but still needed improvement.
4. The category of energy consumption in both operators is the operator's energy needs are moderate but still needed improvement.

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