Electricity Used in Madrasah Ibtidaiyah Negeri (MIN) 1 Pekanbaru: Saving or Wasteful Situation?

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Abstract. This research was conducted at Madrasah Ibtidaiyah Negeri I (MIN 1), a state Islamic elementary school in Pekanbaru. The school is located on Jalan Sumatra Pekanbaru. The school consists of 21 classrooms, one teacher’s room, one administrative room, 1 Principal's office, 1 Vice Principal room, and one emergency room. The buildings use electricity as the source of energy for daily activities, such as for lighting, computer, printers, scanners, water pump, air conditioners and many more. From the data of the research, the electricity is not become a problem for schools, because of the fewer uses of power in educational activities — the use of electrical energy only for lighting the classrooms if the weather not good. The electricity mostly used for office and administration activities such as for the computer, printers, air conditioning, and teaching activities. From the data and the electrical used by MIN 1 Pekanbaru are not too high.

Keywords: Energy; efficiency; Building

1. Introduction

Energy is one of the essential components of the world and for education to carry out the activities of learning and teaching activities. The energy used in primary education is influence the users in general. Therefore, the amount of energy consumption in schools buildings must be calculated to get the rational number. The background of the research are: first, to provide the documents and to measure the efficiency in using the electrical energy. Then, related to the cost of electrical payment by the school every month. MIN 1 Pekanbaru consisting of 23 classrooms, one teacher room, one administration room. 1 Principal's room. And one emergency room. All of the buildings are using electricity for its activities, such as lighting, office equipment; computer, printers, scanners, water pump, air conditioners, and some others.
2. Theory and Hypotheses

The electrical need for building depends on the function of the structure. MIN 1 Pekanbaru. The requirements are:

1. Lighting
2. Air conditioning
3. Water pump
4. Computers
5. Printers
6. Scanners
7. Televisions
8. In focus
9. Heating elements etc

The type of electric load consists of 3 categories:

1. Resitive burden
   Some tools are using resistive burdens such as incandescent Lamp, Electric Iron, Electric Stoves and others. The electrical parameters used by resistive burden are voltage and current in phase, the phase difference is zero and the power factor = 1. The Resitive burden is produced by electric devices that are purely resistors (resistors) in heating elements and incandescent lamps. This resistive burden has a "passive" nature, which is unable to produce electricity, and instead consumer the electricity. Resistors block the current which is passing through (by reducing the current-voltage). The result is the conversion of electrical energy to heat. The resistor will not change the properties of AC electricity. Current waves and electrical voltages that pass through the resistor will form hills and valleys. In other words, the resistive burden will not shift the current wave position or AC power voltage

![Sinusoidal Wave Resistive AC electricity](image)

2. Inductive burden
   The electronic appliances that used inductive currents are TL lamps and electric motor motors. The electrical parameter of the inductive burden is between 0 to 90 degrees; the power factor is between 0 to 1 lagging

3. Capacitive burden
   The electronic appliances use capacitive burden like as television and equipment that use capacitors

2.1 Electricity burden
   The size of the electrical burden is determined by the burden type and amount of burden which is used in each room in a building. All of the expenses are recorded through the electricity meter.

There are three types of electrical power, namely real power, reactive power, and apparent power. False power is a combination of real power with reactive power. The unit used for real power is Watt,
the unit for reactive power is VAr (Volt-AmpereReactive), and the unit used for apparent power is Volt-Ampere. The amount of power can be calculated by using:

\[
S = \sqrt{P^2 + Q^2} \quad \text{................ (1)}
\]

\[
S = P \pm jQ
\]

Where :

S = Apparent power (VA)
P = Active Power (watt)
Q = Reactive Power (VAR)

The minimum power factor that must be met by the load connected to the government Plant Power (PLN) network is 0.85 lagging. Customers will be excellent if they have less power than the minimum limit. The fine can be reduced or eliminated by installing reactive power compensation on the side of the current. The comparison between active power in units of Watts (kiloWatts) with real power in groups of Volt-Ampere (Kilo Volt Ampere)

\[
PF = \frac{kW}{\sqrt{kW^2+KVAR^2}} \quad \text{........... (2)}
\]

The size of the losses that occur during the operation of equipment can be used to measure the instrument for the efficiency of the machine or electrical equipment — the effectiveness of rotating/moving devices ranges from 50% to 60% due to friction and wind losses.

The intensity of Energy Consumption

Energy Consumption Intensity (IKE) is a term used to express the amount of energy use per square meter of the gross area (gross) of a building in a certain period. (Budi Agung Raharjo)

The Energy can be calculated if:

1. Details of the building area and total building area (m2).
2. Energy consumption of buildings per year (kWh / year).
3. Energy Consumption Intensity (IKE) of buildings per year (kWh / m2 / year) Building energy costs (Rp / kWh)

\[
IKE \left(\frac{kWh}{m^2}\right) = \frac{\text{Totalkonsumsi ener}}{\text{luas lentai total (m2)}} \quad \text{.... (3)}
\]

The Costs of Energy Usage

The cost of electricity consumption for the necessary electricity tariff for social purposes follows the government (ESDM) Regulation Number. 31/2014

3. Research Methods

The research was conducted in Madrasah Ibtidaiyah Negeri Pekanbaru in October 2017. In doing the research, some equipment and measurement instruments are needed, like as; Lux meter, Amp Ampere, Volt Meter, Meter. This study was used a detailed casuistic design in September 2017.
4. Result and discussion

MIN 1 Pekanbaru, has 21 classroom:
1) grade 1 consists of 4 classroom
2) grade 2 consists of 4 classroom
3) grade 3 consists of 4 classroom
4) grade 4 consists of 4 classroom
5) grade 5 consists of 3 classroom
6) grade 6 consists of 3 classroom

The school activities started from Monday to Friday, while Saturday and Sunday are holidays. Learning activities begin at 7:30 a.m. From 6.45 to 7.30, the students are in the schoolyard for Quran citation, flag ceremonies, gyms, etc. At 7:30 a.m. - until 12:00 p.m. Learning activities and a 15-minute break. At 12-13 o’clock is prayer time. From 13.00 to Ashar prayer time, continued learning activities. After Ashar prayer, all learning activities have ended. The remaining activities are the activities of teachers and janitors.

The building’s structure was designed to penetrate the sun from the north side and the south side. There are classes alongside of sunlight from the east and west including the female teacher's room. The administration room and the principal's room only gets sunlight from one side. This design, make the different lighten of the sunlight between the rooms, starting from 50% for the administration room and the principal's office, until 90% at classrooms and prayer room.

Table 1. Data of burden’s point

| No | Room             | large | high | Burden points |
|----|------------------|-------|------|---------------|
|    |                  | long  | wide |               |
| 1  | Grade 1          | 9     | 9    | 4             | 5               |
| 2  | Grade 2          | 9     | 9    | 4             | 5               |
| 3  | Grade 3          | 9     | 9    | 4             | 5               |
| 4  | Grade 4          | 9     | 9    | 4             | 5               |
| 5  | Grade 5          | 9     | 9    | 4             | 5               |
| 6  | Grade 6          | 9     | 9    | 4             | 5               |
| 7  | Grade 7          | 9     | 9    | 4             | 5               |
| 8  | Grade 8          | 9     | 9    | 4             | 5               |
| 9  | Grade 9          | 9     | 9    | 4             | 5               |
| 10 | Grade 10         | 9     | 9    | 4             | 5               |
| 11 | Grade 11         | 9     | 9    | 4             | 5               |
| 12 | Grade 12         | 9     | 9    | 4             | 5               |
| 13 | Grade 13         | 9     | 9    | 4             | 5               |
| 15 | Female teachers  | 9     | 9    | 4             | 6               |
| 16 | Male teachers    | 9     | 8    | 4             | 5               |
| 17 | Administration   | 5     | 4    | 4             | 8               |
| 18 | Principal        | 6     | 5    | 4             | 4               |
| 19 | Vice principal   | 4     | 3    | 4             | 3               |
| 20 | Emergency        | 9     | 9    | 4             | 6               |
| 21 | Library          | 5     | 4    | 4             | 4               |
| 22 | Cooperation      | 3     | 2    | 3             | 1               |
| 23 | Teacher’s Toilet | 2     | 2    | 3             | 1               |
| 25 | Prayer room      | 14    | 9    | 3,4           | 12              |
| 26 | Student’s Toilet | 1.5   | 6    | 3             | 4               |
| 27 | Student’s Toilet | 1.5   | 6    | 3             | 4               |
|    | Total            |       |      | 123           |
Table 2. Kinds of burden

| No | appliances   | type          |
|----|--------------|---------------|
| 1  | Lamp         | Hannoch       |
| 2  | Air conditioner | LG and Changhong |
| 3  | Computer     | PC            |
| 4  | Printer      | Epson MP 230 and L220 |
| 5  | Water pump   | Sanju SJ 370  |
| 7  | fan          | GMC           |

From the above, the electrical currents are used for:

a) Administrative activities
b) Lighting in teaching and learning activities
c) Evening Lighting
d) Air Conditioning
e) Water Pump
f) Other electronic equipment

Most of the electrical burden used for lighting of the classroom for learning activities can be seen in table 1. Then for administrative activities, and for cooling the room. However, the most significant energy was used for air conditioning and administrative activities, because of the low watt lamp are used in most of the classroom and the sunlight, make the low-cost budget, as seen in table 2. The use of electrical energy can be categorized as regular energy consumption.

5. Conclusion

With 3500 and 2200 social power connections, Madrasah Ibtidaaiyah Negri (MIN 1) Pekanbaru can be served well and efficient. The form of electricity use in the Madrasah Ibtidaiyah Negeri I Pekanbaru has the following pattern:

a. The number of Energy burden points has the following sequence; indoor lighting, out dor lighting, administrative functions and air conditioning.
b. Most of Energy is using more dominant for air conditioning functions, administrative functions, and lighting functions.
c. The use of electrical energy for academic functions, such as laboratories, libraries only for lighting functions is quite lower.
d. The equipment used is seen from the brand and the year of purchase does not include material that uses energy-saving technology.

6. References

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