REVIEW OF LED SUPREMACY ON THE PURSE SEINE FISHING VESSEL

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ABSTRACT

Fishing vessels with purse seine fishing gear in fishing operations are desperate need of lighting, in addition to supporting the activities on board are also used as fish collectors/attracters so that the species of pelagic fish that became the main commodity catchers can be attracted and gathered to the light generated at ship. In the coastal areas of Tegal City, lights on this type of fishing boat generally use a type of mercury lamp which each unit has a large enough power, in addition to less economical and the periode of use is not long, also less focus of light generated from the lamp, it needs to be updated which is more economical and efficient, and more focused light generated by the light into the collection of fish to be caught. With this efficiency both technically and economically the use of LED lamps have advantages when compared with other types of lights used in purse seine fishing vessels in general.

Keywords: purse seine, pelagic, mercury lamp, LED light, focus.

INTRODUCTION

Based on several studies on the use of lamps in fishing gear, it can be seen that the source of light source power and the intensity of light has a major influence in the effort to attract fish (Arthur Brown et al., 2013).

The use of lamps by fishermen in Indonesia has not been effective, efforts have been made by fishermen focusing more light into the net to make fish concentrated under the lights. This methode has not given optimal results, because the light is still distributed too wide, not focused under the light (Gondo Puspito et al., 2017).

The split focus of the fish is caused by the placement of the light unit that spreads in all directions, so that it is not focused on one side of the ship. Supposedly the placement of the unit of lamp aids is placed on one side of the ship to facilitate in focusing the hordes of fish that have become the target of catching. The mechanism of fish attracted to light can not be known clearly, but allegedly the gathering of fish is caused by the desire to find the appropriate intensity of light power (El Gammal, F.I. and S.F. Mehanna, 2005; Ménard, F et al., 2000).

The use of the type of lamp used in fishing boats with purse seine fishing gear generally uses brighter lights without thinking of the electrical load caused by the use of lights with a large power, such as types of High Pressure Mercury (HPM), namely limiting the discharge current using a ballast, therefore the relatively low *power factor* is 0.5. The inner tube is made of hard glass so it can be used at relatively high temperatures. The workings of mercury lamp consists of 3 stages of ignition, stable achievement process, and stable. When the supply voltage is applied an electric field exists between the initial working electrode and one of the main electrodes. This causes the discharge of both electrodes and heat up the surrounding mercury. To evaporate the mercury it takes 4 to 8 minutes. After all mercury becomes gaseous, the initial working electrode resistance rises due to heat and current flowing between the main electrode through the gas. The initial working color is reddish and after normal work the resulting light is white (Muhaimin, 2001).

LED light (Light Emiting Diode) is defined as one semiconductor that converts electrical energy into light. As with all other LED the consist of semiconducting materials P and N. When the source is applied to the negative LED pole connected to N and the positive pole with P holes will flow towards N and the electrons flow towards P (Muhaimin, 2001).

LED are hardware and solid so that it is superior in terms of durability. The lifetime of the LED lamp can reach 50,000 hours, this is because the direct current working voltage (VDC) is constant, although in the supply of AC currents, but inside the LED there is a stabilizer that stabilizes the AC current supply (Sri Pringatun et al., 2011).

But for the use of LED lights on fishing vessels, especially with purse seine fishing gear rarely or even not used, the reason light is generated from these lights are less reach and do not attract the attention of fish, especially the type of pelagic fish as the main commodity of this type of fishing gear.

Purse seine is a fishing tool whose main part is a net, used for catching large pelagic fish or small pelagic fish according to the size and quantity. Purse seine fishing gear consists of bag (bunt), net body, net edge, float, float line, wing, weights (lead singker), purse line, rope, ring, and selvage. Fish that became the catching destination of purse seine are pelagic fishes that form hordes near the surface of the water. It is also desirable that the density of shoal is high, which means the distance of fish with other fish should be as close as possible (Ayodhyoa, A. U, 1981).

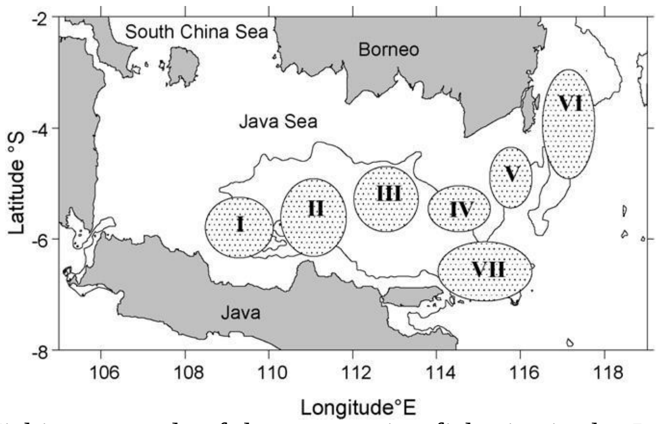

Figure 1. Fishing grounds of the purse seine fisheries in the Java Sea (Massimiliano Cardinale et al., 2009)

The differences with this study lies on the size of cone shape reflectors opening angles ($\alpha = 46.6^0$ and 65.2^0), and main catch organism namely squid. The result proves that lift net which use cone shaped lamp reflector α 46.6^0 and α 65.2^0 obtained weight of catch with 1.8 times and 1.6 times more than cylinder reflector. Another studies used as reference on this research are usage of reflector in fluorescent lamp on lift net fishing (Puspito and Suherman, 2012), utilization of Light Emitting Diode lamp on lift net fishery (Puspito et al., 2015).

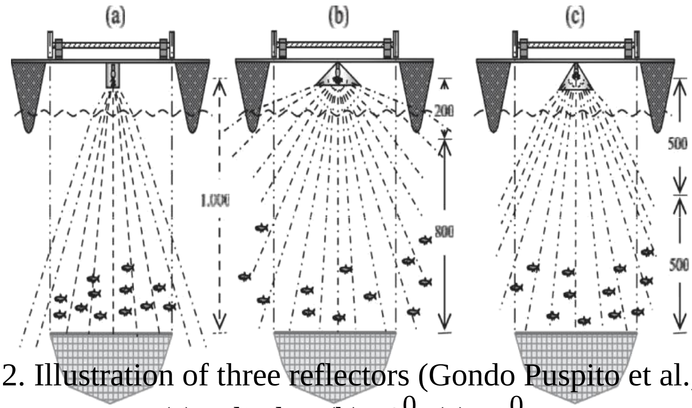

Figure 2. Illustration of three reflectors (Gondo Puspito et al., 2017)
(a) cylindre; (b) 90^0; (c) 62^0

METHODS

The method in the preparation of this paper is to conduct literature studies of several papers and other sources, and make direct visits to the site.

RESULT AND DISCUSSTIONS

1. LED lamp

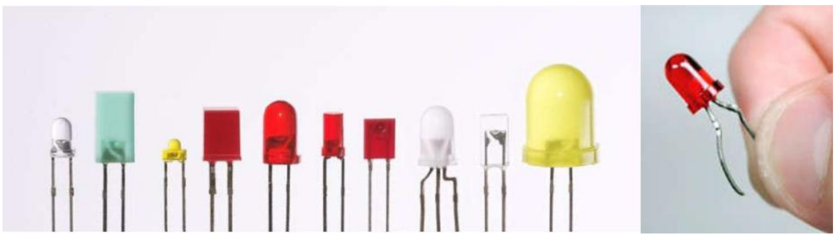

Figure 3. LED shape and size (Lia Kurniawati, 2008)

Conventional LEDs are made from varied inorganic minerals, producing the following colors (Hanum Naomi and Amien Rahardjo, 2013) :

- *aluminium gallium arsenide (AlGaAs)* – red and infrared
- *gallium aluminium phosphide* – green
- *gallium arsenide/phosphide (GaAsP)* – red, orange red, orange, and yellow
- *gallium nitride (GaN)* – green, pure green/green emerald, and blue
- *gallium phosphide (GaP)* – red, yellow, dan green
- *zinc selenide (ZnSe)* – blue
- *indium gallium nitride (InGaN)* – bluish green and blue
- *indium gallium aluminium phosphide* – orange red, orange, yellow, and green
- *silicon carbide (SiC) as substrate* – blue
- *diamond (C)* – ultraviolet
- *silicon (Si) as substrate* – blue (in development)
- *sapphire (Al2O3) as substrate* – blue

Table 1. Some Specifications of Lamp Types (Sri Pringatun et al., 2011).

Lamp	Specification
LVD (Low Voltage Discharge)	a ballast with a high frequency, an induction coil, a lamp.
HPM (High Pressure Mercury)	limiting the discharge current using ballast, the power is relatively low 0.5, the inner tube is made of hard glass so that it can be used at relatively high temperature, the age of 12,000-20,000 hours.
HPS (High Pressure Sodium)	HPS lamps are smaller and contain additional elements such as mercury, producing a reddish orange light.
Metal Halide	a discharge lamp where in most of the light is generated by radiation from a mixture of metal vapor (example: mercury) and halide decomposition (halide thallium, indium or sodium)
LED (*Light Emiting Diode*)	a semiconductor that converts electrical energy into light, consisting of a semi conductor material P and N. The negative pole is connected to N and the positive pole with P holes will flow toward N and electrons flow toward P, the lifespan of the LED lamp can reach 50,000 hours, work with direct current (VDC).

Light Emitting Diode luminaires and lamps are energy saving and environmental friendly alternatives to traditional lighting products. However, current luminous flux depreciation test at luminaire and lamp level requires a minimum of 6,000 h testing, which is even longer than the product development cycle time (C. Qian et al., 2016).

Based on its strength and size, LEDs are divided into 2 types, (Vincent Laganier, 2004):

a. LED Low Power
   It has a strength of about 0.1 Watt with a size of 5 mm, and has a luminous flux of about 2 lumens. Usually used for indicator lights on computers, cell phones, etc.
b. LED High Power
   Currently, its power is about 1 Watt and 3 Watt, with a typical luminous flux of about 25 lumens for 1 Watt white diode and increased to 50 lumens for red and yellow diodes. Used for traffic lights, indoor and outdoor lighting.

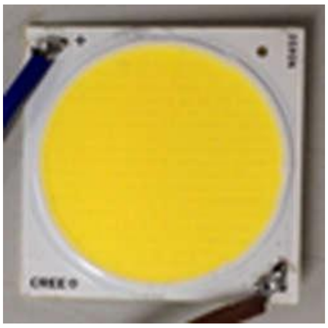

Figure 4. High Power LED (Seok-Hwan Moon et al., 2017)

Optical simulations were conducted to calculate the optical output power of LED package according to the orthogonal experimental design. Range and variance analyses were carried out to determine the significance of the relevant factors on the LED's light output (Qi Chen et al., 2017).

2. Excess LED (Lia Kurniawati, 2008) :

a. LED have high energy efficiency because LED change partly large electrical energy into light so that more energy efficient. The energy used by the LED is about 1/10 of the bulb, and 1/2 of the fluorescent lamp. This figure is expected to continue declining in the near future, with active research in this regard. LED consume only 10-20% power from conventional light sources. When compared to incandescent bulbs that use 150W, using LED will reduce the energy used to 10W.
b. LED can emit a variety of colors without having to use a common color filter used regular lights. So that more efficient and lower maintenance costs. In contrast to incandescent lights that produce a continuous spectrum, LED emit light in a special way so that the monochromatic color quality emitted is higher. The color of the light emitted by the LED depends on the material produced.
c. Wrap solid LED is designed in such a way to focus the emitted light, so that the outgoing light is more focused and bright. Because it does not use filaments such as incandescent lamps, the radiant heat emitted is quite low. In addition, this solid plate makes it stronger, and durable. Unlike light bulbs made of glass are very vulnerable to breaking. LED also do not use easily broken filaments such as incandescent lamps, which can often be switched off and turned on without fear of rapid damage.

d. LED have a long lifespan, which reaches 50,000-100,000 hours. While the age of lasting fluorescent lamps around 20,000 hours. While the absolute age of the bulb lamp, is the filament rupture. With a long life span, LED can save on maintenance costs and new lamp replacement.

e. LED are easy to dimmed without changing the color of the light, unlike the incandescent light that turns yellow when dimmed. In addition, LED also do not take long to turn it on. Unlike Fluorescent and HID lamps that require discharge and ballast time to raise the voltage.

f. The small LED size (mostly around 5mm) makes installation easy. So as to facilitate and allow lighting design with a more varied, dynamic, and attractive lamp form.

g. LED do not contain toxic gases such as mercury present in fluorescent lamps that could harm human health in the event of a leak in the bulb.

3. The weakness of LED lights :

a. LED lamp prices are still very expensive when compared with other lamp lamps.

b. The performance of LED is highly dependent on ambient temperature. Extreme environmental temperature (too hot / cold / fast changing) can damage the LED.

c. Because LED produce monochromatic light, LED do not have exactly the same spectral distribution with sunlight, so white CRI are poor, compared to 100% CRI incandescent bulbs, white LED currently have only 80-85% CRI (Knoop, Martin and Luc van der Poel, 2007).

d. LED with warm colors have a lower effectiveness compared to cold colors.

4. Formulation of lighting

a. Light Flux / Light Flow (Muhaimin, 2001)

The average flow of light energy is the light current or the light flux. The current of light is defined as the total amount of light emitted by the light source every second. The amount of light current with lumen unit (lm) is expressed by equation 1.

$$\mathbf{Ø = Q / t} \tag{1}$$

Where; Ø = the luminous flux in lumen (lm), Q = light energy in lm.hours or lm.seconds, T = time in hours or seconds.

b. Light intensity (Hermawan and Karnoto, 2005)

The intensity of light is the light stream in the lumen emitted in each corner of the space (in a particular direction) by a light source, expressed in equation 2,

$$\mathbf{I = Ø / \omega} \tag{2}$$

$$\mathbf{Ø = I \times \omega} \tag{3}$$

Where; Ø = the luminous flux in lumen (lm), I = intensity in candella (cd), **ω** = space angle in steradian (sr).

White light is a combination of red, green, and blue. White light is generated when all three colors are lit together. In contrast to the pattern of red and blue light distribution that tends to form a circular pattern to form a rectangular flower and high intensity is produced at angles parallel to the lamp, in white light exactly the highest light intensity at around 10-20^0 angle from the direction of the lamp and form the circular pattern resembles a hexagon shaped flower, it is possible that the reflector is more perfect in reflecting white light than other colors because the light of the white color is more diffuse and other colors tend to be straight (Eko Sulkhani Yulianto et Al., 2014).

c. Ilumination (Hermawan and Karnoto, 2005)
is the density of the luminous current flow falling on the surface of a single unit area, when the surface is uniformly illuminated.

$$\mathbf{E = Ø / A} \tag{4}$$

Where; E = illumination lux (lx) = lm/m^2, Ø = the luminous flux in lumen (lm), A = wide area (m^2).

Due to usage and depreciation factors due to dust on luminaire and lamps, the equation must be multiplied by the coefficient of utilization (CU) and light-loss factor (LLF). By Schiler (1992), the formula is expressed more clearly by:

$$E = \frac{N.n.LL.CU\ .LLF}{A} \tag{5}$$

Where; N = amount luminaire , n = number of lamps per luminaire, LL = lumens produce by each lamp, LLF = light loss factor, A = wide area (m^2).

d. Lumination (Muhaimin, 2001)
is a quantitative statement of the amount of light reflected by the surface in a direction.

$$\mathbf{L = Ø / \omega\ R} \quad (6)$$

$$\mathbf{L = I / R} \quad (7)$$

Where; L = lumination nit (nt) = cd/m^2, Ø = the luminous flux in lumen (lm), I = intensity in candella (cd), R = point distance/area (m^2).

e. Light Efficacy (Muhaimin, 2001)
is the ratio of the flux of light to the power

$$\mathbf{K = Ø / P} \quad (8)$$

Where; K = light efficacy in lumen/Watt (lm/Watt), Ø = the luminous flux in lumen (lm), P = electric power in watts (W).

5. Efficacy of Lumen

The efficacy of the LED lumen continues to progress from year to year. Starting from 1999, Philips Lumileds created LEDs that can operate at 1 watts of power. In 2002, LEDs evolved into operating at 5 Watts of power with efficacy of 18-22 lm/W. In 2003, blue LEDs introduced by Cree, Inc. had a efficacy of 34 lm/W. And in 2006, the efficacy of LEDs reached 131 lm/W and Nichia Corp. has developed white LEDs achieving 150 lm/W efficacy (A. Gegana and Gregorius, 2007). And now, the efficacy of white LED has reached 200-220 lm/W (Lia Kurniawati, 2008).

Evidently, a white light source will have a lower lighting efficiency as it will include wavelength for which the eye response is not optimum, and an ultraviolet or infrared light-emitting device will have a lighting efficiency of 0 lm/W (Bruno Gayral, 2017).

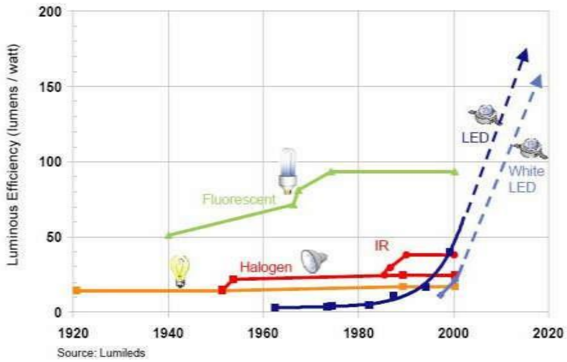

Figure 5. Graph of the development of efficacy (Lia Kurniawati, 2008).

6. Lumen Depreciation

Despite having a long life time, the LED also decreases lumen with the duration of use so that LED is not as bright as initially. This decrease depends on the type, for RGB LED luminal depreciation can reach 50% of first out light and white LED has luminal depreciation up to 70% of its initial light.

Table 2. Comparison of mercury lamps with LED lights (Lia Kurniawati, 2008).

Specification	Mercury Lamp	LED lamp
Length (inch)	5 – 16	0.2 – 1
Electrical Power (Watt)	50 – 1,000	0.03 – 5
Efficacy (lm/Watt)	25 – 65	50 – 200
Average life time (hours)	16,000 – 24,000	50,000 – 100,000
Start and restart time (minutes)	3 – 9 (start) 5 – 10 (restart)	instant
Dimming	made possible with the circuit and additional equipment	be completely
Light issue (%)	14	25 – 52 (60 – 80 in theory)
Lumen Depreciation	medium	very good
Color rendering	bad good (non continuous spectrum) bad display colors red	medium good (spectrum is not continuous) nice in showing yellow, bad showing green color and blue
General application	landscape, road, signage, industry	accents, signage, exterior

It is rare for an LED to fail completely. LED lifetimes can vary from 3 months to as high as 50,000–70,000 h based on application and construction (Moon Hwan Chang et al., 2012).

With a control scheme resulting in constant emitted total luminous flux significant electricalmpower saving can be achieved since at lower temperatures, due to increasing efficiency/efficacy less electrical power, thus, lower forward current levels are sufficient (J. Hegedüs et al., 2017).

CONCLUSIONS

a. LED lamps in both technical and economical terms are superior other types of lamps, for example, are mercury lamps.
b. Reflector settings are very influential on the focus generated from the light of the resulting light, and the efficacy of the LED lumen continues to progress from year to year.
c. The placement and position of the lights on the fishing vessel of the purse seine type of fish should be more precise and focused, because it serves as the attention of pelagic fish collection.

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