

## Research Article

### Research on LED Fishing Light

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**Abstract:** In this study, the semiconductor lighting technology with advantages of energy saving, environmental protection and high rapid response speed is regarded as the fishing light source, which can achieve targets of energy conservation, emission reduction, environmental protection, scientific fishing, etc. Then, the characteristics of LED are described to conduct a comparative analysis with the metal halide light source which has been commonly used in fishing light. The results show that LED is more suitable to be used as the fishing light source.

**Keywords:** Attracts LED, fishing light, metal halide light

#### INTRODUCTION

Using light is a common way to trap fish in fishery industry. Attracting fish by light is to induce them to form a large shoal using the artificial light source at night taking advantage of fish's photo taxis. Therefore, fishing light is the most important fishing accessory equipment in fishing attraction by light, which mainly includes filament lamp, halogen tungsten lamp, low-pressure mercury light, high-pressure mercury light, metal halide light and other electric light resource, all belonging to thermal light source. As the major fishing equipment, fishing light can be divided into overwater fishing light and underwater fishing light. Energy is the material base on which people rely for survival and development, so energy conservation and emission reduction is a crucial issue facing by the public when the current global energy is deficit. The investment in fishing light and fuel consumption has exerted a significant influence on the operation revenue of fishing attraction by light. The semiconductor lighting technology is an effective way for energy conservation and emission reduction. Qian *et al.* (2005) shows a comparative study on the light intensity distribution of 2 kinds of underwater fishing light. Zhou *et al.* (2006) gives the design and application of led drive circuit. Wang (2008) gives a preliminary study on the vision damage of juvenile fish at the upper water layer affected by the fishing light intensity-taking the mullet as an example. Liming Electronic Technology Co. Ltd in Xian (2008) gives the underwater marine fishing light with high-power and blue-green led. Li (2010) give the research on the design of led underwater fishing light. Jia Bao Xieli Electronics Co., Ltd,

Shanghai (2009) gives the underwater fishing light of light-emitting diodes.

In this study, the semiconductor lighting technology with advantages of energy saving, environmental protection and high rapid response speed is regarded as the fishing light source, which can achieve targets of energy conservation, emission reduction, environmental protection, scientific fishing, etc. Then, the characteristics of LED are described to conduct a comparative analysis with the metal halide light source which has been commonly used in fishing light. The results show that LED is more suitable to be used as the fishing light source.

#### LED CHARACTERISTICS

LED (Light Emitting Diode) is an electroluminescent light source and a semiconductor device that can directly converts electrical energy into visible light and radiant energy. The principle of LED light-emitting is to use a solid semiconductor chip as luminescent materials. When both ends are applied the forward voltage, the injected hole in the PN junction of semiconductor material compounds with electrons, leading to the photon emission to produce light, which directly converts electrical energy into light energy. It is a cold light source. Compared with other forms of lighting, LED light source has many advantages, is an ideal lighting appliance.

**Energy saving and environmental protection:** In recent years, oil price has risen sharply and the proportion of fuel investment of the light fishing fishery also has increased significantly and sometimes the fuel consumption of thermal light source fish light accounts

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for more than 50% of the total fuel consumption of fishing vessels. Thus, fuel consumption cost on fishing light attractor has generated obvious impact to the operation revenue of the light fishing fishery.

The metal halide light has many disadvantages of low luminous efficiency and high power consumption and most of the electrical energy being transformed into heat. LED's spectrum is almost entirely concentrated in the visible light frequency bands, with the optical efficiency up to 80%ig ~ 90%. Therefore, the LED has low power consumption and under the same lighting effects, it saves more than 50% energy compared with metal halide lights.

The light emitted by the metal halide light contains large amounts of ultraviolet and infrared radiation. If it is applied to light fishing, it would impair the well-being of fishing boats staff. Besides, photo taxis fish in the middle and upper level of the sea, especially for those young and juvenile fish whose visual system has not yet developed, will also be exposed to some damage<sup>1</sup>. While as a cold light source, LED does not contain infrared and ultraviolet components or radioactive contamination, which can effectively prevent the destruction of fisheries ecology.

The filler of metal halide light contains mercury or other heavy metals, so the damaged and abandoned lights will cause harm to human health and the environment. However, LED does not produce hazardous substances and the waste can be recycled. It produces zero pollution, has no mercury elements and is a typical green light source.

**Good spectral properties with concentrated beam and easy to control:** The spectrum of metal halide light is relatively wider and its light-emitting direction is an entirely cubical space, which is not conducive for the effective usage of light distribution and light ray. The LED spectrum is the discrete spectrum with FWHM of the spectral line around 30 nm. Various types of LED have different peak wavelengths, which can match different spectral structures within the effective photosynthetic radiation range. LED has bright colors as well as diverse color selection and light distribution. Besides, LED light is mostly concentrated on the center with small divergence angle, which can effectively control the glare. LED light can instantly response to the current, so the light intensity and color can be adjusted just by adjusting the current.

**Safe and reliable with long life:** Due to the special working conditions of the fishery production, lights have to be used in surf beat and ship shaking, so shockproof and water resistance is a must. The metal halide light has glass bulb, filament and other fragile components, so it is fragile and poor in shock resistance. In addition, its operating voltage must be up to hundreds of volts and its life-expectancy is about 3,000 h. When it is applied as an underwater fishing

light, it's necessary to put it into water and then turn on the light; the light should be turned off first before being taken out of water. If any carelessness, the complex operation may lead to an explosion and electric shock.

LED is to encapsulate the solid light source using epoxy. It utilizes the low voltage (DC voltage required by a single LED is 1.5V to 4 V) and is drove by the low current, so its service life is up to 60,000 ~ 100,000 h. As an all-solid-state structure, it can withstand vibration and shock without being damaged, coupled with the low non-normal retirement rate and its maintenance is very convenient.

## LED FISHING LIGHT

LED fishing light should meet the following requirements: light source should have great lighting range and sufficient illumination and can be applied to trap fish; the starting operation is easy and quick; lights should be sturdy, shock-proof and pressure -proof; durable.

**LED drivers:** Although LED owns high light efficiency, the luminous flux emitted by a single LED is not sufficient enough, so it is necessary to combine several LEDs in order to achieve a large illuminated range and sufficient illumination. First, determine the total power according to the illumination range and illuminancy required by LED fishing light and then select several LEDs with a certain power to achieve the total power. The LED combination is completed by the unit circuit board. First divide them into several sections and then merge them together in the array structure, distributed as linear, rectangular, round, inside and outside semi-cylindrical and partially spherical to ensure that the light scatters around, thereby achieving the fish attraction.

Several LEDs are generally connected in series, parallel and hybrid (Fig. 1). A specific connection way should be determined by different drive ways.

Discrete element drive circuit or integrated drive circuit is adopted in the LED driver circuit. When driving LED, the high-voltage AC generated by the fishing boat should be transformed into the low-voltage AC, which should be transformed into the low-voltage DC by the bridge rectifier and then decompressed and transformed into the constant current by the switching regulator with high efficiency. The constant current is input to drive LED to illuminate.

The digital control circuit is adopted, which includes the control system circuit regarding the embedded MCU (Micro Control Unit) as the core and the display control circuit. The display control circuit can be divided into three modules: R (red), G (green).B (blue) (Fig. 2). The connection structures of LED drivers within these three modules should be identical with those between these modules and MCU. Through

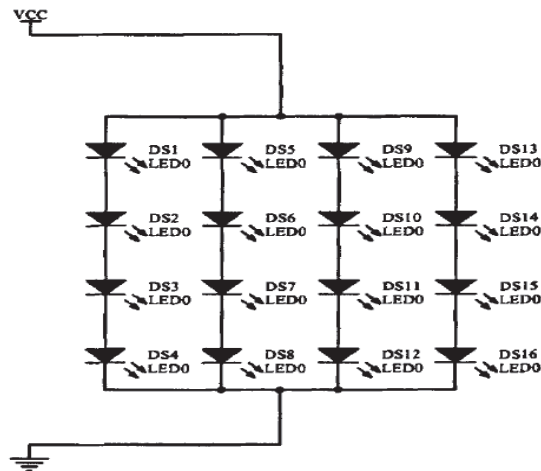


Fig. 1: Parallel serial circuit diagram of LED

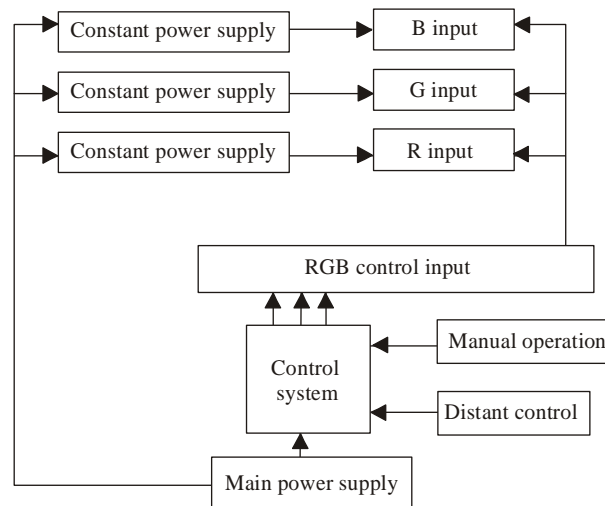


Fig. 2: Brightness and chrome control system

the control program installed in MCU, the control signal and data is sent to the LED driver chip by MCU and then the LED driver chip can control every LED according to the requirement of control signal and data. If the MCU continuously sends control signals and data to the LED driver chips, the single LED will obtain continuous coordination and control, which can achieve dynamic display with various colors and changes for the fishing light.

The brightness and chrome of simple LED fishing light can be controlled by mechanical switches.

**Cooling:** The cooling design is a key technology for success or failure of LED. Design of the heat transfer should consider the heat capacity of contacting directly with the cooling body of LED devices. The large heat capacity can absorb and balance the instantaneous thermal shock, preventing thermal damage to LED devices caused by the high temperatures generated by instantaneous over current. Another thing should also

be considered is the balance conditions and traffic of the heat transfer to make sure that the heat generated by the LED devices within the fishing lights can successfully reach the external water. The heat problem is solved by packaging the substrate. Through holes are made on the cooling substrate to enable it to directly contact with sea water, so that sea water cycles in the through holes, achieving the purpose of cooling.

### APPLICATIONS OF LED FISHING LIGHT

Characterized by small size and flexible package, LED can be made into fishing lights with forms of point, lin, surface and others. LED fishing lights can be mad into different shapes, such as spherical and straight tubular and different sizes. Firmly encapsulated by the outer transparent package, LED fishing light is highly reliable at waterproof.

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point, line, surface and others. LED fishing lights can be made into spherical and straight tubular and a variety of shapes and different sizes. Firmly encapsulated by the outer transparent package, LED fishing light has highly reliable waterproof performance.

Studies have shown that phototaxis of fish subject to many factors. It not only has a complex relationship with temperature, salinity, transparency, flow, tidal current, wind direction, wind and many other factors in the marine environment but also relates to fish species, the physiological state of the fish itself, such as age, sexual maturity, degree of stomach plumpness.

LED fishing light can attract fish according to the objective situation of the fisheries, such as different characteristics of fish physiology and ecology, brightness, color and dynamic changes of light source. LED fishing lights can not only display food, images of the similar category and a variety of things that fish likes to attract them and but also shows images of fish's predators to drive the fish shoal. In this way, we can achieve the goal of controlling fish, fishing relying on science, rational development and utilization of fisheries resources, protection of fish reproduction and proliferation and the sustainable development.

## CONCLUSION

The use of LED semiconductor lighting has been recognized as an important way of energy saving and environmental protection. The semiconductor lighting technology is rapidly developed and widely applied, with strong connections with other industries and huge energy-saving potential, which has been acknowledged as the most promising and efficient lighting industry. Large-scale application of LED in the lighting area is on the way. The field of LED has raised considerable concern over domestic and foreign investment institutions. LED industry has become a hotspot of investment.

China has launched a green lighting project and the semiconductor lighting project in succession. In the ten key energy conservation projects, high-tech industrialization demonstration projects, technological upgrading and structural adjustment projects for enterprises and the new materials field of State 863 Projects have successively supported research and development and industrialization of semiconductor lighting technology project. On September 22, 2009, the Chinese Development and Reform Commission and other six ministries announced the views about semiconductor lighting energy industry. This statement makes clear seven policy measures for the development

of semiconductor lighting industry, including: overall planning, promoting healthy and orderly development, continuing to increase support of semiconductor lighting technology innovation and actively implementing and promoting the incentive policies of the development of semiconductor lighting energy industry.

The research and application of LED fishing light involves fish behavior, marine optics, marine meteorology, chromatology, materiality, electronic technology, electronic control technology, mechanical technology and other disciplines. Therefore, this kind of research is cutting-edge and comprehensive, so the interdisciplinary research and cooperation is necessary due to the considerable technical difficulty. R and D institutions should focus on the technology of LED fishing light and the oncoming products and utilize various resources to make full use of the advantages of synergies techniques, thereby achieving effective cooperation in the development of key technologies, industrialization, intellectual property rights sharing to break all kinds of technical limitations.

## ACKNOWLEDGMENT

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