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LIGHT TECHNICAL INSTALLATIONS FOR FISH FEEDING

Summary

Light technical installations with optimum color characteristics of optical radiation attract mosquitoes to the water surface of a pond where they are swarming. It results in increasing in the pond of the number of chironomids which are alive foods for fish. In the experimental pond compared with the control one mobility of fish in the twilight and at night in the area of electro-optical converters activity fish actively eats the attracted insects. It is getting into significant improvement of epio-zootechnical situation in the ponds.

СВЕТОТЕХНИЧЕСКИЕ УСТАНОВКИ ДЛЯ ПОДКОРМКИ РЫБЫ

Аннотация

Светотехнические установки с оптимальными цветовыми характеристиками оптического излучения привлекают к водной поверхности пруда комаров, где и происходит их роение. В результате чего в пруду увеличивается количество хирономид, являющихся живым кормом для рыбы. На опытном пруду, по сравнению с контрольным, резко увеличилась подвижность рыбы, в сумеречное и ночное время рыба в зоне действия электрооптических преобразователей активно поедает привлеченных насекомых. Все это приводит к существенному улучшению эпиозоотической ситуации в прудах.

Meeting the needs of the population in fish products is associated not only with the expansion and improvement of fishing in the world oceans, but also with the rational use of inland waters. At present when in many inland waters it is carried out a complex usage of water resources it is necessary to preserve and enhance fish stocks through effective reproduction.

Larvae of adult mosquitoes (midges) are a favorite, natural and ecology friendly fish food. Attraction of mosquitoes to light increases in 5-10 times the number of chironomid larvae in ponds.

Let's consider the requirements to color emission, which technology of intensive fish breeding gives. When density of fish is more than 300 kg/ha, natural food is not enough and it is used a forage for fish feeding. It breaks a correlation between living and nonliving food being in natural conditions, and it leads to fish immunity and ponds productivity decrease. To overcome this disadvantage they attract mosquitoes to reservoir.

It is necessary to use light technical installations not to kill insects but to attract them to water surface. To increase the number of chironomids in the pond it is advisable to use the platform located near light technical installation emitters (Figure 3).

The investigations showed that to increase an attractive effect for mosquitoes we should optimize a mixture of ultraviolet emission and visible emission.

To determine color efficiency of attractive emission (mixture of visible emission) these were used emissions with wavelength of 624, 522, 469 nm. Consequently the criteria of mosquitoes flight intensity optimization, that is a quantity of mosquitoes attracted with a mixture of three emissions during an hour, is influenced by three factors: $e_к$ – illumination in a control point from an emission with 624 nm wavelength in a code form; $e_з$ – illumination in a control point from an emission with 522 nm wavelength in a code form; $e_с$ – illumination in a control point from an emission with 463 nm wavelength in a code form. To construct a three-phase model it is realized a matrix of composite planning for n = 3.

It is solved an equation of second level regression expressing mosquitoes flight intensity on light technical installations emission in dependence on color coordinates of attractive emission on the Atlas of the International Commission on Illumination (ICI), graphical interpretation of which is given in Figure 1.

$$W = -516{,}447 + 2503{,}09 \cdot x + 4146{,}665 \cdot y - 4717{,}456 \cdot x^2 - 1429{,}17 \cdot x \cdot y - 8080{,}817 \cdot y^2, \quad (1)$$

where:
x – coordinates on the abscissa of color diagram ICI, o.e.;
y – coordinates on the vertical axis of color diagram ICI, o.e.

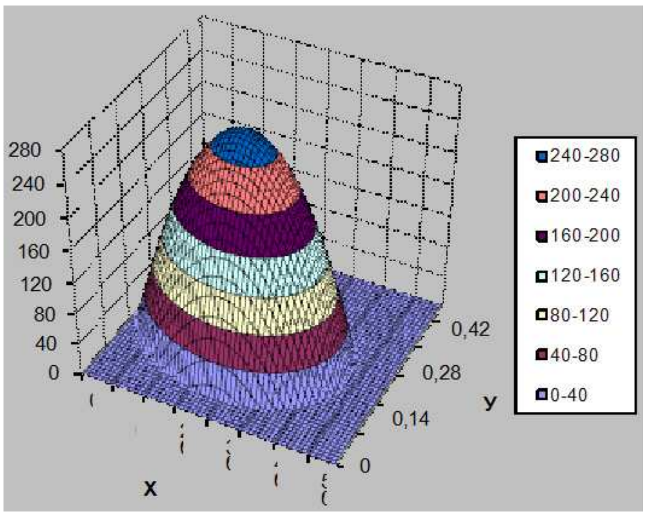

Figure 1. Mosquitoes flight intensity W [p/h] in dependence on color mixture of light-emitting diodes visible emission

Color coordinates of gas discharging light technical installation (figure 2) with a continuous emission spectrum *φ (λ)* can be calculated according to tables of specific color coordinate values that is the meaning of color coordinates of homogeneous emission of 1W power, correspondent to a middle wavelength interval $\Delta\lambda$, in limits of which the emission can be considered homogeneous ($\Delta\lambda$ = 5–10 nm).

An equation for color coordinates can be written as /1/

$$\begin{cases} X = \Delta\lambda \sum_{i=1}^{n} \varphi_{\lambda i} \overline{x_i}\,, & (2) \\ Y = \Delta\lambda \sum_{i=1}^{n} \varphi_{\lambda i} \overline{y_i}\,, & (3) \\ Z = \Delta\lambda \sum_{i=1}^{n} \varphi_{\lambda i} \overline{z_i}\,. & (4) \end{cases}$$

where: $\Delta\lambda$ – a width of a chosen spectrum interval, nm;
$\varphi_{\lambda I}$ – a value of spectrum efficiency of a ray flux for a middle *i*'s spectrum interval;
$\overline{x_i}, \overline{y_i}, \overline{z_i}$ – values of specific color coordinates for *i*'s spectrum interval.

Figure 2. Light technical installation with gas discharging lamps

The calculation of color coordinates of diode light technical installation (figure 3) can be done by using the following relationships /1/

$$\begin{cases} X = \sum_{i=1}^{n} \overline{x_i} \Phi_i\,, & (5) \\ Y = \sum_{i=1}^{n} \overline{y_i} \Phi_i\,, & (6) \\ Z = \sum_{i=1}^{n} \overline{z_i} \Phi_i\,. & (7) \end{cases}$$

where: Φ_i – a value of homogeneous ray fluxes, W.

To characterize color emission these are used correspondent values of color coordinates, named color coordinates [1]:

$$x = \frac{X}{X+Y+Z}\,, \quad (8)$$

$$y = \frac{Y}{X+Y+Z}\,, \quad (9)$$

$$z = \frac{Z}{X+Y+Z}\,. \quad (10)$$

To characterize color emission it is enough only two coordinates allowing to depict color emission graphically using a point in a rectangular coordinate system.

Light technical installations with optimal color emission work automatically, turning on in a night time and accumulating electroenergy out of solar cells during a day time.

Figure 3. Light technical installation with the brightest diode emitters

Fish breeding technology requires an even distribution of light technical installations on the pond surface to prevent fish crowding. During May, June, July light technical installations attract mosquitoes to pond water surface, where they are swarming. As a result the number of chironomids, which are alive foods for fish increased in the pond. In the experimental pond compared with the control one mobility of fish in the twilight and at night in the area of light technical installation activity fish actively eats the attracted insects. All this leads to significant improvement of epiozootechnical situation in the ponds.

In the experimental ponds where light technical installations were put, biomass of benthos exceeded control signs in 4 times (1295 mg per m^2 against 318 mg per m^2); in a bolus there was more food of animal origin in 3 times.

Literature

[1] Gazalov V.S.: Light technique and Electrotechnology. Part 1. Light technique/ Tutorial. Rostov-on-Don: OOO "Terra", 2004, 344 c.