PUBLIC HEALTH AND CONTROL OF NON-IONIZING RADIATION IN JAPAN

Hiroyoshi Iida and Tokusaburo Koshijima
National Institute of Radiological Sciences
Chiba-shi, Japan

Abstract

Some effective measures against a certain laser radiation is reported and the general situation in Japan concerning the protection of people against non-ionizing radiations is described.

Studies made on the possible protective measures against the harmful effect of laser radiation, particularly on the eye and skin, revealed that the following three methods are effective against He-Ne laser radiation of 6,328 A, 1) absorption by cellophane sheet, 2) absorption by filter and 3) reflection by non-metalic multilayer film.

A number of studies on biological effect of microwave radiation and laser radiation have been conducted in Japan. There are, however, no regulations on the permissible level of these radiations such as those set forth against ionizing radiations on human body. Recently, home microwave ovens are pervading rapidly. In view of these situations, the "Research Committee on Biological Effect of Non-ionizing Radiation from Home Use Instruments" was organized in the Ministry of Health and Welfare last year.

Currently, regulations are applied to the manufacturers of these devices by the Ordinance of Ministry of International Trade and Industry.

Introduction

The results of investigation on protection against laser radiation are described, together with an introduction to the present situation of public health control against non-ionizing radiations in Japan.

The use of laser radiation has been growing in physics research, telecommunication, metal processing, cancer treatment and etc., by which are required higher energy and peak power of laser and hence the increasing problems of protection. Apparently, the laser radiation hazard is caused mainly by heat absorbed, but the true mechanism is not yet revealed. The eye is the tissue of the most interest to be protected against laser radiation followed by the skin.

Radars, which are essential to navigation safety, aerial control, meteorology, naval and military affairs and etc., radiate electromagnetic wave characteristic to their purpose. Recently, home microwave ovens are pervading rapidly, hence

microwave radiation came into contact with the public. The biological effects of microwave radiation are explained mostly by thermal effect.

Protection against lasers

Since laser beam is directional and its energy can be converged in a very small area, heat of very high intensity is absorbed in a small region of the tissue and burns it.

To protect against laser radiation, following methods are available, i.e., (I) to use material which absorbs laser energy, (II) to use material which reflects laser radiation. Both methods are possibly as far as the materials used do not burn out. (III) Shielding around the laser path is necessary to protect high energy or pulsed laser.

The laser beam used in the present study was the radiation of 6,328 Å wavelength continuously generated from the 10mW He-Ne equipment (Nippon Kagaku Kogyo). Absorption or reflection of the laser beam by a number of substances was examined by the use of photometer and illuminometer together with other spectroscopic analysis. Absorption by commercially available cellophane sheets is shown in Table 1. Spectrophotometric analysis is shown in Fig. 1. Cellophane sheets of green or purple provides effective protection against He-Ne 6,328 Å laser radiation. Absorption by glass filters (Toshiba) is measured as shown in Table 2. From the view-point of absorption coefficient, glass filters are far inferior to cellophane. In general, the absorption by glass filter is effective due to its thickness.

Reflectance was measured of one type of mirror of non-metalic multilayer film (Vacuum Optics Corporation of Japan, Fig. 2) which showed reflection of 97.9 %.

Apparently, protection against other kinds of laser radiations is possible by selecting suitable materials for absorption and reflection.

Table 1. Absorption coefficient of cellophane sheet

Colour	green	purple	blue	red	yellow	colourless
Absorption coefficient (/mm)	98	69	27	4.8	2.4	0.47

(Thickness of one sheet = 20 μm = 2.9 mg/cm^2)

Table 2. Absorption by optical glass filters (Toshiba).

	VG 52	VG 54
Thickness	2.75 mm (0.70 g/cm^2)	3.17 mm (0.78 g/cm^2)
Absorption	99.9 %	99.8 %
Absorption coefficient	2.51 /mm	1.95 /mm

Protection against microwaves

Microwave ovens used by the general public should be designed and manufactured as to leak no radiation from the ovens. Control area should be established around microwave radiator so as to

protect the public from radar radiation. It is well known that copper wire netting is effective to protect researchers and workers from direct microwave radiation (Fig. 3).

According to a research by Dr. K.Ban (Nagoya University), protection clothes or protection box which is made of cupper wire netting of 24 mesh is effective against 2,440 MHz microwave radiation. Scattered radiation inside the clothes or box was nearly zero[1].

Regulations on control of non-ionizing radiations in Japan

There are no regulations on the permissible level of these radiations such as those set forth against ionizing radiations on human body. The estimated number of laser equipments is about 30,000 (Table 3) and that of ovens, much rapidly pervading, is about 1,300,000 (Table 4) as of Dec. 31, 1972 in Japan. In view of these situations, the "Research Committee on Biological Effect of Non-ionizing Radiation from Home Use Instruments" (Chairman, Dr. N.Yamagata) was organized in the Ministry of Health and Welfare last year. The Committee collected and examined many domestic and foreign literatures on biological effect of non-ionizing radiation, and also investigated foreign regulations. A report on the above was published by the Committee.

Table 3. Estimated number of laser equipments in Japan (as of Dec. 31, 1972)

Total number --- approximately 30,000			
Domestic ---	95 %		
Imported ---	5 %		
Gas laser ---	95.2 %	He-Ne	92.4 %
		Ar ---	1.8 %
		CO_2 ---	0.7 %
		Others	0.3 %
Solid state laser	4.8 %		
Others ---	few		

(Estimated from the data of Industrial Marketing Consultant Co., LTD)

Table 4. Estimated number of microwave ovens in Japan (as of Dec. 31, 1972)

Year	Number
1969	311,492
1970	413,901
1971	299,428
1972 approximately	610,000
total produced "	1,630,000
exported "	330,000
domestic use "	1,300,000

(Estimated from the data of Research & Statistics Division, the Ministry of International Trade and Industry)

Currently, regulations are applied to the manufacturers of these devices by the Ordinance of Ministry of International Trade and Industry as follows.

(1) Frequency of the microwave should be within the range of (2,450 ± 50) MHz.
(2) There should be installed such as additional cut-off device for the oscillator as is motivated by opening the oven door.
(3) Radiation leakage measured at any 5 cm distance from the oven under the condition that a beaker containing (275 ± 15) ml of water is placed at the centre within the oven should be
    a) less than 1 mW/cm^2 when the door is shut, and
    b) less than 5 mW/cm^2 when the door is ajar to the maximum extent before the cut-off device operates.
(4) Radiation intensity, except that of the frequency within (2,450 ± 50) MHz, should be
    a) less than 25 $\mu V/m$ at 300m from the oven of under 500W, or
    b) less than $25\sqrt{P/500}$ $\mu V/m$ (where P is the out-put in W) at 300 m and less than 10 $\mu V/m$ at 1,600 m from the oven of above 500 W.

This Committee is expected to examine actively on the maximum permissible energy on human body.

Reference

1. Kazutomo Ban: Studies on biological effects of microwave radiation (1st report), Nippon Acta Radiologica, 22, (6) 743-749, 1962.

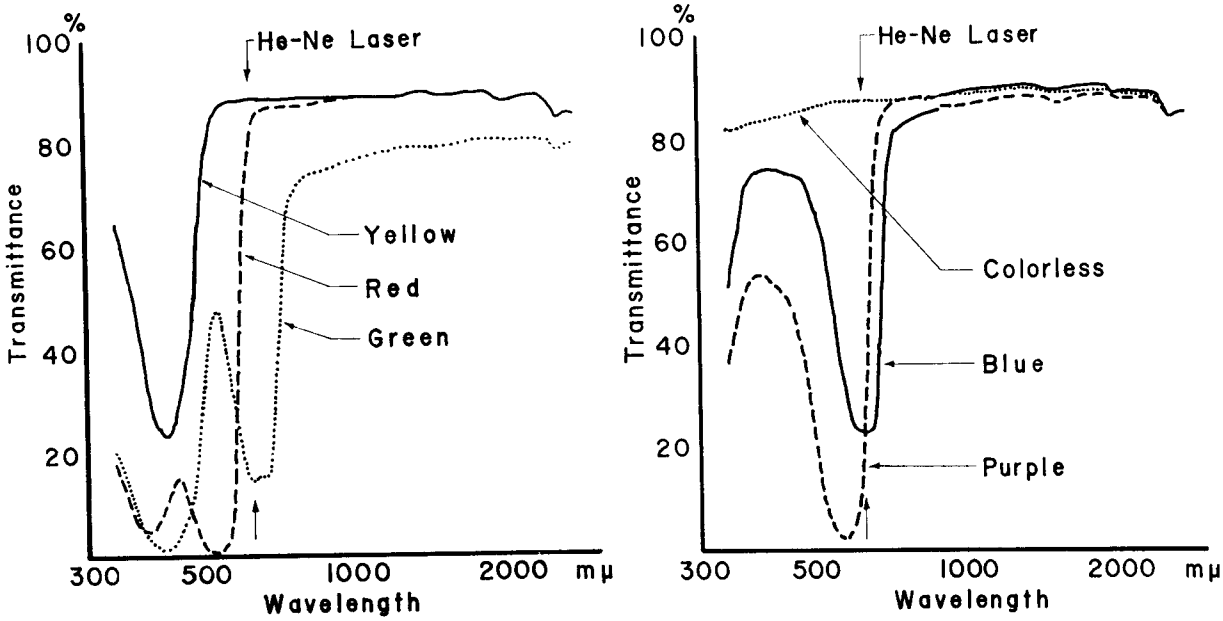

Fig. 1. Spectroscopic transmittance of coloured cellophanes.

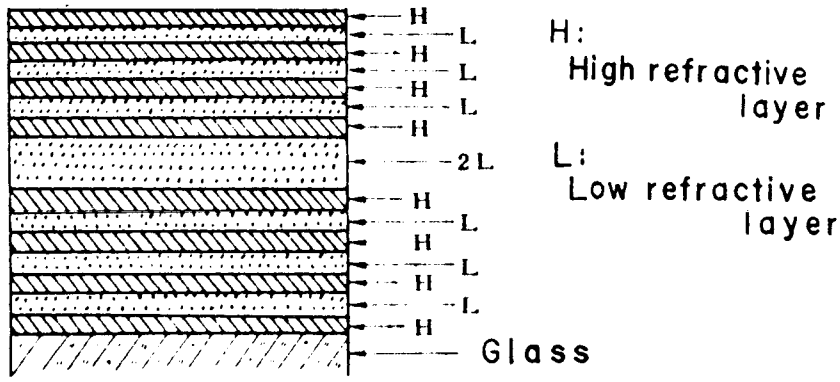

Fig. 2. Mirror of non-metalic multilayer film.

Fig. 3. Garment for protection made with 24 mesh copper nets.