MR 1739

AUTHORS: Meterless...

DATE: 1977

TITLE: Meterless monitoring of radiation now in sight.

SOURCE: Microwaves 16:10, 12

MAIN SUBJECT HEADING:

AN	HU	AT	IH	M
ANALYTICS	HUMAN EFFECTS	ANIMAL TOXICITY	WORKPLACE PRACTICES-ENGINEERING CONTROLS	MISCELLANEOUS

SECONDARY SUBJECT HEADINGS: AN HU AT IH M

Physical/Chemical Properties

Review

Animal Toxicology

Non-occupational Human Exposure

Occupational Exposure

Epidemiology

Standards

Manufacturing

Uses

Reactions

Sampling/Analytical Methods

Reported Ambient Levels

Measured Methods

Work Practices

Engineering Controls

Biological Monitoring

Methods of Analysis

Treatment

Transportation/Handling/Storage/Labelling

MR 1739

Senate probes RF hazards

(continued from p. 9)

alphabet soup of agencies from military and government, most attesting to indications, but citing little evidence of health hazards. "For example, it appears that microwave exposure will produce cataracts only at very high power levels," claimed Maj. Lawrence Larsen, who is assigned to Walter Reed Army Institute of Research as associate chief of medical biophysics in its Department of Microwave Research.

He said the study is part of an Army microwave research program that includes investigations of frequency-dependent energy absorption in physical models (scaled figurines of a man), animals and in organ-specific studies.

Other witnesses outlined similar studies—such as the Navy's probe of microwave and extremely low frequency (ELF) radiation in support of its Project Seafarer Communications System—but the pattern of testimony was consistent. Compared with research into ionizing radiation, the non-ionizing area is an infant where there are no accepted theories as to damage production by any mechanism other than thermal. Yet, there are experiments whose results cannot be explained by thermal means.

William Thaler, acting director of the White House Office of Telecommunications Policy, summed the situation for the Senators. "Non-ionizing EMR research is far more complex than ionizing radiation. There are difficulties in relating how much energy is absorbed from incident radiation or 'exposure.' It is even more difficult to determine the distribution of that energy within the body.

"In assessing the impact of this radiation on man one must first develop a realistic picture of actual exposure environments and the populations which are involved," Thaler explained. "It appears that radiation levels in most environments normally encountered by the general public are well below 10 mW/cm², although levels of a few milliwatts/cm² do occur in some occupational situations."

Thaler also indicated that the problems concerning the US embassy in Moscow are more worthy of headlines than headaches. The level of radiation has dropped considerably since the State Dept. complained, and the two countries have recently signed an agreement to conduct collaborative research in the microwave area.

If the National Academy of Sciences is given a mandate to coordinate studies in the field, it already has a head start. It has previously carried out studies on the effects of microwaves on samples of Korean war Navy veterans who were exposed to microwaves from radar, and will intensify the probe concerning the mortality of the vets. Late last year, the National Aeronautics and Space Administration asked it to perform an assessment of a research plan to determine the biological and ecological effects of energy transmission by microwaves, a proposal it has broadened and discussed with a number of agencies.

The Academy is also developing a proposal to study the impact of over-the-air communications systems and on other microwave utilizing systems that would result from taking regulatory action on non-ionizing radiation.

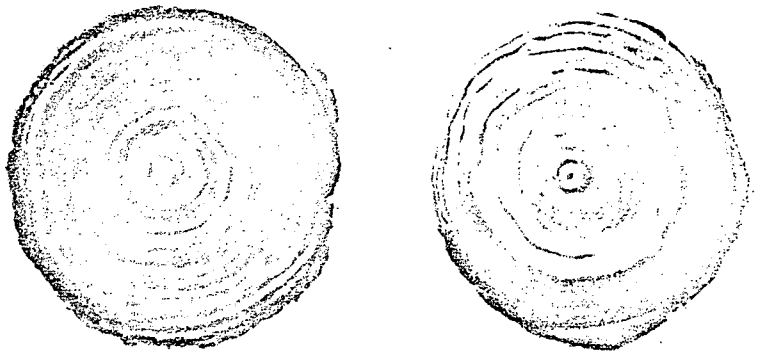
"A Congressional mandate to the Academy to coordinate these efforts would be invaluable," remarked the subcommittee counsel. "It would add greater prestige and visibility to the project, assure Federal money and probably increase activity here. It's early in the study, and there's no better time to coordinate so we can begin answering the many questions."••

Meterless monitoring of radiation now in sight

Commercial broadcasting, radar, portable transmitters and a multitude of industrial sources bathe us in radiation, the effects of which are not yet fully determined. The possibility that some of this non-ionizing radiation may be hazardous spawns the need for an effective radiation monitor that can be inexpensively mass produced in large quantities.

With this in mind, Dr. Glenn Fanslow and Dr. D.T. Stephenson of Iowa State University have developed a novel, entirely passive device to monitor non-ionizing radiation. The approach takes advantage of the temperature-dependent light scattering properties of cholesteric liquid crystals—the substance used in passive digital thermometers. The liquid crystal, painted on plastic disks, indicates power densities as low as 1 mW/cm² without any batteries, moving parts, circuits, or meters of any sort.

"The goal in this work," Dr. Fanslow relates, "is to provide an effective but convenient means of monitoring radiation. The calorimetric radiation monitor needs no electronics, no meters and no power source. The simplicity of the device suggests that it can be produced at low cost and made readily available to anyone who wants to measure radiation and locate radiation leaks."



*1. **Without radiation present,** color indication is shown by circles of equal radius. When radiation is present, the metalized disk displays a color circle of larger radius than the non-metalized disk. Increments on the indicator give a level of the radiation present (in this case, 4mW/cm²).*

The prototype radiation monitor consists of two plastic temperature sensing disks. One disk, coated with metal, absorbs radiation when it is present. The second disk, unmetalized, acts as a control element. Both disks are first coated with black paint to absorb light scattered by the liquid-crystal material. Various compounds of the liquid-crystal substance are then

(continued on p. 12)

Steven Peliotis, Western Editor

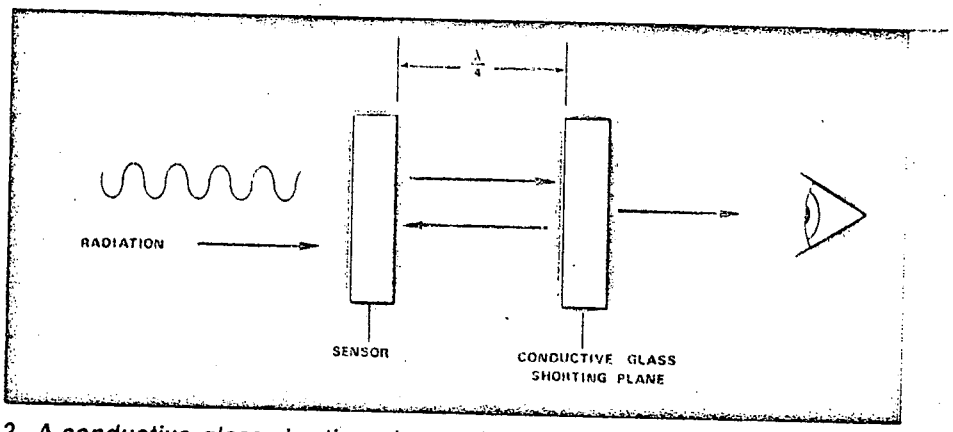
Meterless monitoring of radiation (continued from p. 10)

painted on the disks in concentric circles.

"A change in the temperature of a material coated with liquid crystals causes a change in color," Dr. Fanslow comments. "In general, the color will pass from red to green to blue as the temperature increases, and it will be limited to a temperature range. This range is determined by the compounds or mixtures of compounds used."

Thus, with no radiation present, the circles on both disks displaying color would have the same radius (both indicating ambient temperature). When radiation is present, the metalized disk absorbs energy, heats up and displays a liquid-crystal circle of larger radius. Using the non-metalized disk as an ambient temperature representation, the difference between temperature indications on the two disks can be used as a measure of radiation.

An experimental version described by Dr. Fanslow at June's International Microwave Symposium in San Diego, CA, is fabricated with 10 concentric liquid-crystal circles (Fig. 1). The temperature required for a color change is 88°F at the outermost circle, and decreases in 2°F increments with each smaller circle. A green color on circle number eight, for example, would indicate a temperature of 84°F. Since liquid crystal compounds change in color from red to green to blue with increasing temperature, it is possible to estimate temperatures that fall on either side of a ring's center temperature.



2. A conductive glass shorting plane reflects energy back into the radiation monitor. Sensitivity is enhanced and a clear view of the sensor is provided.

Temperature rise indicates radiation

A proposed configuration for a practical radiation monitor utilizes a movable indicator in a stationary guide. The non-metalized disk provides the reference for ambient temperature. By moving the indicator's reference point to the appropriate circle on the non-metalized disk, the level of radiation can be read on the incremented end of the indicator.

Several designs for the radiation monitor are being considered. A simpler approach would be to configure it as a linear sensor/indicator, akin to passive liquid crystal thermometers. Dr. Fanslow explains that a linear device would be more understandable. Future efforts will explore various forms of the sensor to optimize performance.

One modification that shows promise is the placement of a piece of conductive glass one-quarter wavelength away from the liquid-crystal film (Fig. 2). The system takes on the look of a transmission line with a $\lambda/4$ matching stub. The conductive glass shorting plane reflects energy back to the sensor. Sensitivity is increased without obscuring the view of the sensor.

Liquid crystal calorimeters exhibit the beauty of simplicity. Properly used, the lifetime of the device is expected to be without limit.••

Licensees sought to produce NBS-developed RF power meter

Manufacturers can now obtain a license and design package to produce a new RF power meter recently developed and patented by the National Bureau of Standards (NBS).

The meter, designated by the NBS as Type IV, is an improvement over the Type II power meter that has been produced commercially since a similar design package for it was offered in 1971. The Type IV meter retains the accuracy of the self-balancing bridge portion of the Type II, in a smaller package, and at about one-third the cost. It was designed specifically for use in automated measurement systems in which as many as 10 power meters would be under the control of a computer, and would share a single digital voltmeter and digital-to-analog converter. This is in contrast to the Type II (a manually operated system) in which every power meter assembly usually included a "reference voltage generator" module. The new approach reduces total system cost, and it has important operating advantages.

Wheatstone bridge eliminated

Like its predecessors, the new power meter uses the DC-RF substitution method for measuring power. Unlike Types I and II, however, it does not use a Wheatstone bridge. The Type IV uses two operational amplifiers to automatically maintain equality between the resistance of a thermistor mount and the meter's internal standard resistor to within one part in 10^5. Doing away with the bridge and the use of four-terminal resistor connections eliminates the lead-resistance errors inherent in thermistor-to-bridge connections. It also permits the convenience of longer connecting lines between meter and thermistor.

The design package includes working drawings, a complete parts list with names of suppliers, specifications for non-standard parts required, photographic negatives for printed circuits and artwork (front and back panels and meter scale) and an operating manual. The package and a license are available through the National Technical Information Service, U. S. Department of Commerce, 425 Thirteenth Street, N. W., Washington, DC 20004 (202) 724-3374. ••*SVB*