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Protected UV Cabinet for Chemistry Laboratory: A Special Design for Improved Efficiency and Safety

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ABSTRACT

Laboratory safety is a very important aspect of science. Without it, experimentation could result in very serious injury. Thin Layer Chromatography is very useful to chemists as an analytical technique to separate and identify the compounds in a mixture using chromatograms. In this technique, the chromatograms must be detected under ultraviolet lamp. The design and working of a new unit, protected ultraviolet cabinet, is presented in this paper. This unit can be used for easy viewing and marking of chromatograms and also for safe laboratory.

Keywords: Safe laboratory, UV cabinet, TLC

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INTRODUCTION

Ultraviolet (UV) rays make up part of the electromagnetic spectrum of light and radiant energy. The sun is the primary source of UV. The UV light can not be seen and it is shorter in wavelength than visible light. The shorter the wavelength, the more energetic the radiation, and the grosser the potential for harm. People and plants live with both useful and hurtful effects of UV radiation from the sun. UV rays have positive effects, for example, are necessary for our body to generate vitamin D, a material that helps strengthen bones. UV disinfection is now an admitted technology for inactivation of a variety of waterborne pathogens in waste water and drinking water. On the other hand, studies have shown that increased UV radiation can cause considerable damage, particularly to small animals and plants. UV light has the potential to cause many adverse effects on the body including causing the cancers melanoma and squamous cell carcinoma. It is believed that the cases of the bulk of skin cancers have been recognized UV radiation. UV is divided into at least three different categories based on wavelength: UVA wavelengths (320-400 nm) are only slightly affected by ozone levels. Most UVA radiation is able to reach the earth's surface and can contribute to skin aging, eye damage, and immune suppression. UVB wavelengths (280-320 nm) are strongly affected by ozone levels. Scientific concern over ozone depletion in the upper atmosphere has prompted extensive efforts to assess the potential damage to life on earth. UV-B induces skin cancer by causing mutation in DNA and suppressing certain activities of the immune system. UVC wavelengths (100-280 nm) are very strongly affected by ozone levels, so that the levels of UVC radiation reaching the earth's surface are relatively small. Without the layer of ozone in the stratosphere to protect us from excessive amounts of UV radiation, life as well know it would not exist¹⁻³.

On the other hand, Thin Layer Chromatography (TLC) is a technique which used in drug analysis, consumer product monitoring, environmental pollution studies and many other applications^{4,5}. TLC consists of a stationary phase collected on a plate, and an organic solvent. The sample, either liquid or dissolved in a volatile solvent, is residue as a spot on the stationary phase. The constituents of a sample can be identified by simultaneously running standards with the unknown. Finally, the separated materials are visualized with ultraviolet light.

Hardly any TLC laboratory can be without the use of UV light for investigating chromatograms. However, UV lamps which use in chemistry laboratories generally do not proffer significant protection from UV light.

In this paper, we introduce a safe UV cabinet is suitable for inspecting TLC and other objects in a

closed box.

A chemistry lab is a location of learning. However, in the absence of suitable safety procedures it can become a dangerous environment. Students should have to make laboratory as a safe location for knowledge and skills development. The students' interest in chemistry is abated as they have the perception that the use of equipment's is dangerous and it is very difficult to manage chemistry experiments.

The dangers of UV exposure are real, and common idiotism concerning these matters could steer to increased health problems in the future. In continuation of our research^{6,7}, protected UV cabinet is a reducing agent the risks on the design of chemistry laboratory. This unit (Figure 1) is designed for easy viewing and marking of chromatograms.



Figure 1- UV cabinet; Base measures, outer dimensions 270 × 380 × 300 mm

For the protected UV cabinet, all the equipment's are easily accessed and set up as they are all kept in a closed box, which minimize movement of the students in the laboratory when they select chromatography for separation to perform the experiments.

In our unit, under UV light, colorless organic materials absorbing at that wavelength become visible. These substances appear as dark ultraviolet spots on a bright background (Figure 2).

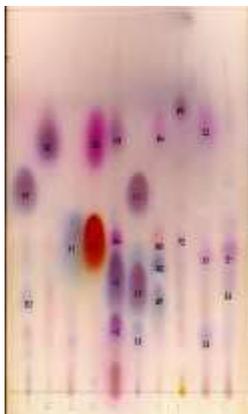


Figure 2- Separated materials under UV light⁸

On the other hand, our protected cabinet decreases the levels of UV radiation that reach the operator.

Front of the box is closed with a roller shutter, which can be slid as required for inserting TLC or plates. This compact comes complete with a 8-watt UV lamp (254 nm). The UV lamp is removable and can be used separately. Great care has been taken to ensure the correct distances between UV lamp, object and the observer's eye in the interest of good illumination and untroubled viewing. A lens is designed for effective imaging of thin layer chromatography plates. The lens accommodates, fixed to a handle in central of the cabinet, for transportation of it. A pen on the peripheral side of the cabinet warrants darkness and enabling the operator to adjust the samples and highlights easily or marking the spots. Access to the interior of the cabinet is via a hard board on the roof of cabinet. This chromatogram viewing cabinet can be combined both long and short wave ultraviolet.

CONCLUSION

UV rays are used in various experimental functions, such as disinfecting fish tanks, sterilizing medical equipment and chemistry laboratory. There are some manmade lamps and tools that can produce UV radiation. UV radiation leads to the generation of reactive oxygen species. These molecules exert a variety of harmful effects by altering key cellular functions and may result in cell death⁹. Therefore, it is a great challenge for schools and universities to protect their students and staffs from chemical risk as well as to save chemicals, energy, and environment. In this paper, we introduced the safe cabinet for efficient and powerful illumination of TLC plates and chromatograms. With the design of new UV cabinet in laboratory, chemicals are used in a smaller amount, safer and involved minimum usage of energy for work-up. This cabinet increases student interest in a safe and environmentally friendly way.

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