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MEASUREMENTS OF THE AIR POLLUTION EFFECTS ON THE COLOR PORTIONS OF SOLAR RADIATION AT HELWAN, EGYPT

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ABSTRACT

The paper contains examples on the distribution of the color percentage or the color portion during very clear days and others polluted days for each season from sunrise (SR) to sunset (SS) and the difference between them. Some important parameters such as the clearness index (KT), diffuse fraction (KD), relative humidity (R.H) and temperature (T) effect on the direct color portions. The monthly variation are given for the four major color bands B1 (530 nm >λ), B2 (530 nm<λ<630 nm), B3 (630nm<λ<695 nm), B4 (λ>695 nm) due to the meteorological and the environmental factors as T, R..H, and visibility. The data measurements are carried out through two years from June 1991 to May 1993, at Helwan, (Lat. 29° 52′ N, Long. 31° 20′ E), which is considered as the largest industrial region in Egypt.

KEYWORDS

Direct solar radiation, color portion, air pollution.

INTRODUCTION

Measurements of the different spectral bands of direct solar radiation (I) are important to know the variation of color percentage through different seasons and the air pollution effects within the different spectral bands. This paper contains examples on the distribution of the color percentage or the color portion during very clear days and others polluted days for each season from SR to SS and the difference between them. Some important parameters such as the KT, KD, R.H and T affect on the color portions. The major sources of pollution at Helwan are from three types of factories (Cement factories, Engineering industries, Iron and Steel factories). Earlier studies carried out in this field in Helwan area [1 to 3]. The aim of the research are: Measurement of effects of the pollution on the different color bands (B1,B2,B3 and B4), the KT= G/Go (G=Terrestrial solar radiation, Go=Extraterrestrial radiation) and the KD=D/G, where D is the diffuse solar radiation (D=G-I cos(θ)), where θ is the zenith angle.

INSTRUMENTS AND MEASUREMENTS

The measurements are carried out through two years from June 1991 to May 1993, from SR to SS, an equipment were installed on the top roof of the building of the NRIAG. The metreological and solar radiation instruments which using in this work includes on the metreological station and solar radiation station (normal incidence pyrheliometer using three color filters bands OG530, RG630 and RG695 and precision spectral pyranometer) made in EBLAB (U.S.A).

RESULTS AND DISCUSSION

As we see from figures (1 to 4), which represents the hourly variation of the color portion for the four major bands B1, B2, B3 and B4 due to the effect of the air mass (M) on these bands on three clear days, and one polluted day as following :-
1- Clear days 14-1-1993 (winter season). 2- Clear days 17-9-1992 (autumn season).
3- Clear days 18-6-1991 (summer season). 4- polluted day 5-11-1992 (autumn season).
The distribution of the color portion (C.P) with the air mass (M) from SR to SS was found as :-

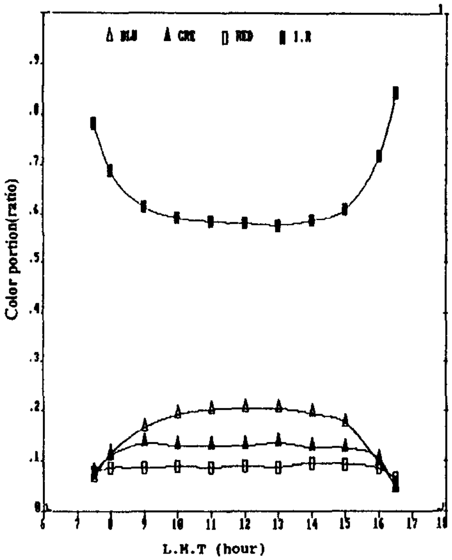
B1 : decrease of C.P with increasing of M. B2 : stability of the C.P with changing M.
B3 : stability of the C.P with changing M. B4 : stability of the C.P for two hours around true noon and increase after two hours from the noon until to the SR or SS. This means that the maximum of Blue (B1) is at true noon (less air mass), while I.R (B4) is maximum at higher M (SR or SS) in different seasons. As we see from figure (4) the curves are asymmetric due to the heterogeneous concentration of pollutants over the days and because the absorption and reflection are different from hour to hour. In the clear days, the curves are symmetrical on the days considered. Figures (5 to 8) represent the ratios among different C.P bands, B1, B2, B3, B4, and the ratios of KT, KD and R.H at different clear and polluted days for the comparison between them . Figure (5) represents the different values of the B1,B2, B3 , B4, KT, KD and R.H on two days, clear day at 14-1-1993 and polluted day at 28-1-1993 in winter season. The increase of pollution leads to decrease of B1 by 20.4% , B3 by 17.17%, KT by 9.75% and increase of B2 by 2.81%, B4 by 4.84% and KD by 106.7%. Figure (6) represents the different values of the B1, B2, B3, B4, KT, KD and R.H to two clear days at 14-1-1993 and 17-12-1991 in winter season. As we see from this figure, the increase of KD by 69.5% lead to the decrease in short λ (B1by 9.3%,B2 by 3.45%), and increase of long λ(B3 by 3.15%,B4 by 5.5%). Figure (7) represents the different values of the B1, B2, B3, B4, KT, KD and R.H on two clear days at 7-11 and 7-12-91 in winter season, where the decrease of R.H by 7.5% lead to decrease of KT by 6.6% and increase in KD by 30.62% lead to the increase of B4 by 5.056 % and decrease of B1 by 5.48%, B2 by 26.26% and B3 by 21.13%. Figure (8) represents the different values of the B1, B2, B3, B4, KT, KD and R.H on two days, one clear day 7-11-91 and polluted one 5-11- 92, where the increase of pollutants and decrease of R.H by 4.32% lead to the increase in B1 by 12.05%, B4 by 2.47% and decrease in B2 by 31.9%, B3 by 24.7%, KT by 20.98% and KD by 48.21%. Table(1) represents the different values to the previous measurements for different values of the B1, B2, B3, B4, KT, KD and R.H on the clear days (8 days), and polluted days (5 days).

Table(1): The different values of the color portion (C.P) bands B1, B2, B3, B4 beside the ratios KT, KD, R.H for different clear and polluted days.

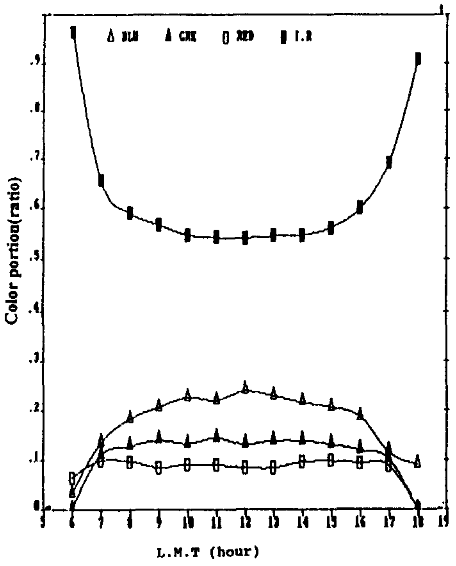
Date	Class	B1(%)	B2(%)	B3(%)	B4(%)	KT(%)	KD(%)	R.H(%)
14-1-93	Clear	17.3	12.45	8.64	60.38	68.7	23.7	69.82
23-3-93	Clear	20.5	13.77	8.93	56.75	78.1	24.3	65.38
18-6-91	Clear	23.7	12.45	8.38	55.46	73.8	16.1	40.16
29-9-91	Clear	18.6	17.1	8.48	55.79	71.1	21.5	50.73
29-9-92	Clear	20.56	13.62	8.78	57.02	68.3	27.78	66.84
17-9-92	Clear	20.41	13.08	9.04	57.45	70	22.9	60.15
7-11-91	Clear	16.6	16.3	11.3	60.32	71	30.7	68.76
17-12-91	Clear	15.69	12.02	8.91	63.37	66.3	40.1	63.6
28-1-93	Polluted	13.77	15.8	7.11	63.3	62	48.9	65.2
4 -3-93	Polluted	19.68	12.53	8.5	59.28	62.4	57.4	55.77
25-6-91	Polluted	20.94	11.15	8.46	59.44	67.2	36.5	56.6
8-9-91	Polluted	16.86	11.2	8.5	61.92	64.6	49.5	58.54
5-11-92	Polluted	18.6	11.1	8.51	61.81	56.1	45.5	65.91

CONCLUSION

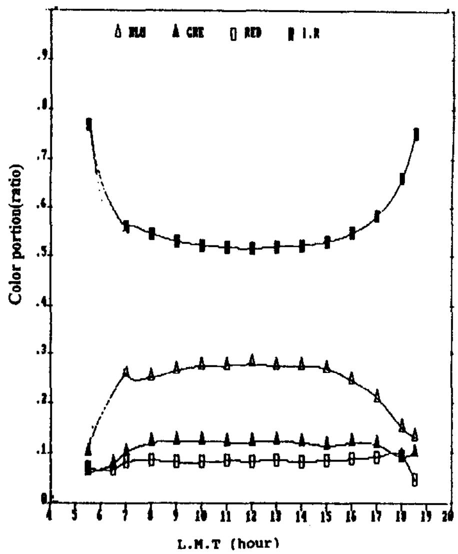
The high percent of the short λ (U.V+Violet+Yellow+Green) on the interval day from sunrise to sunset is at low air mass (M), while the high percent of the long λ (I.R) is at higher M.The R.H is considered as the most effective parameter on the different percentage of colors in clear days and the increasing of R.H lead to shift in the percentage of C.P from the Blue to the I.R. The increase of R.H leads to increase of KD from 6% to 70% , and the increase of R.H in clear days leads to increase B1 by 10%, B3 by 5%, B4 by 3% and decreases B2 by 20% from the original percentage in the clear days. The increase of pollution reduces the B1 from 4% to 18%, B2 from 9% to 18%, B3 from 1% to 24% and increases B4 from 2.5% to 7.2% from the original percentage of the clear days in different seasons.



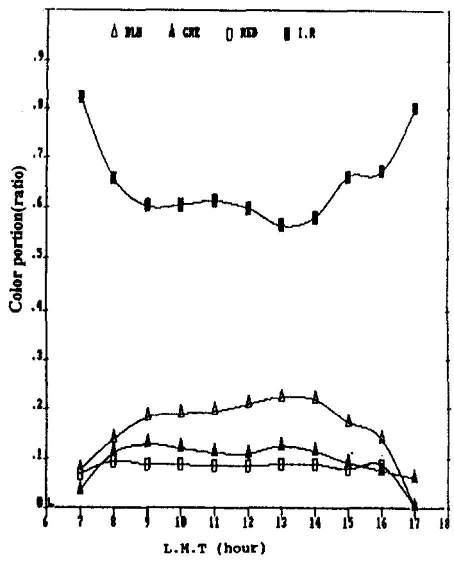
Figure(1) the hourly variation of the color portion for B1,B2,B3, and B4 at mid Jan.month (winter).



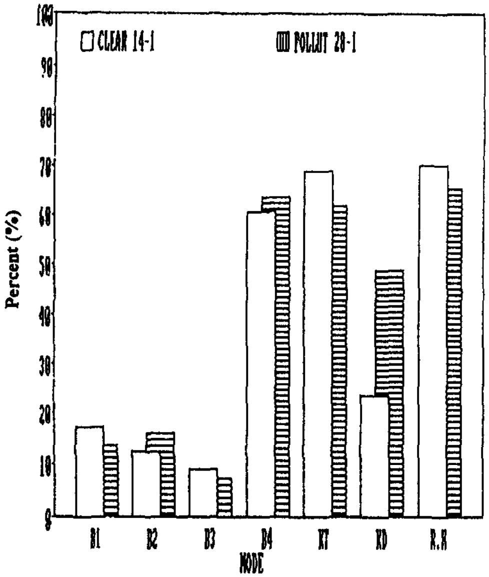
Figure(2) the hourly variation of the color portion for B1,B2,B3, and B4 at mid Sep.month (Spring).



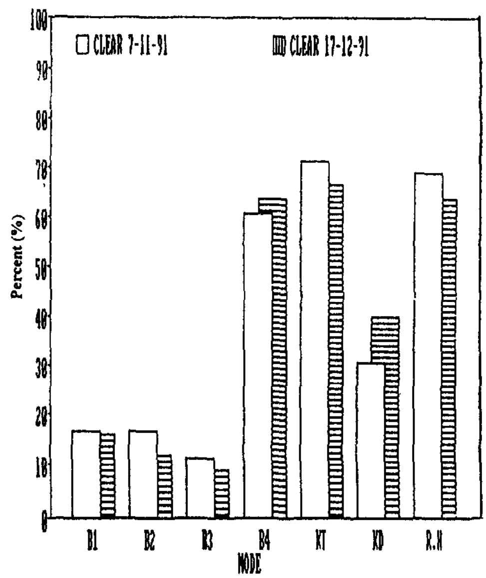
Figure(3) the hourly variation of the color portion for B1,B2,B3, and B4 at mid June.month (Summer).



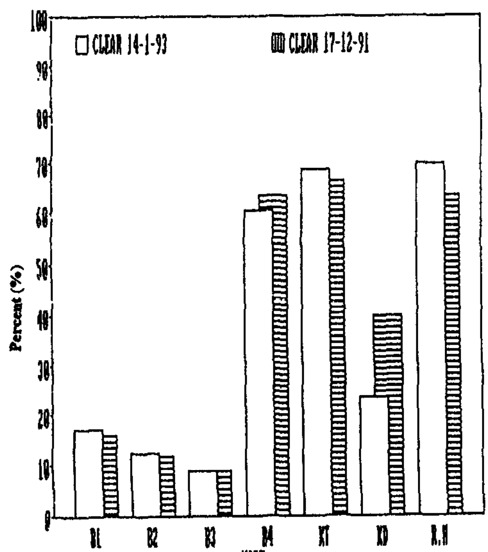
Figure(4) the hourly variation of the color portion for B1,B2,B3, and B4 at Nov.month as the polluted day.



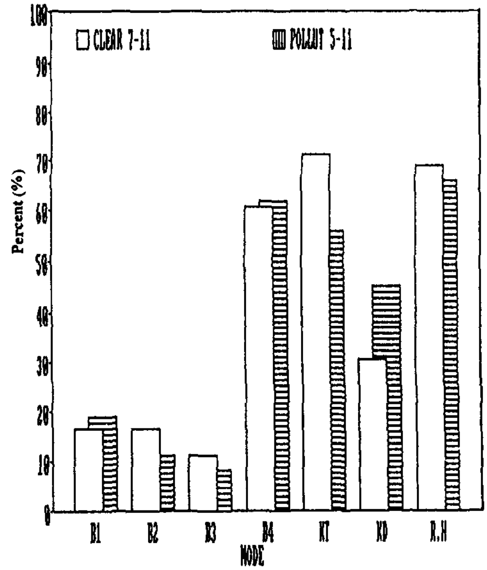
Figure(5) the color portion for B1,B2,B3,B4 and the ratio of KT,KD, and R.H on the total day at 14-1 (clear) and 28-1 (pollute) as the comparison between them.



Figure(7) the different values of the B1,B2,B3,B4,KT,KD and R.H to two clear days(7-11 and 17-12).



Figure(6) the different values of the B1,B2,B3,B4,KT,KD and R.H to two clear days(14-1 and 17-12).



Figure(8) the different values of the B1,B2,B3,B4,KT,KD and R.H to two days, clear(7-11) and pollute(5-11).

REFERENCES

El-Taieb, N. M. (1981). *Some Studies on Air Pollution and Solar Radiation in Helwan Area*, M.Sc. (Al-Azhar University, p. 112.

Mosalam Shaltout, M. A. , M. M. Ghonim and A. H. Hassan (1995). Effects of Air Pollution on the Solar Radiation at Helwan. *Proc. of Technologies for Energy Efficiency and Environmental Protection Conference and Exhibtion*, Cairo, March 26-30, (1995).

Nasralla, M., (1990). Protection of Air Environment from Industrial Pollutants. *Faculty of Science, Helwan University Meeting*, 25 March 1990.