CHAPTER VI
In the present chapter one of the most important parameters, namely, atmospheric stability which has a direct bearing on the pollutant dispersal, is studied along with the wind roses. The pollution potential indices are also discussed in this chapter.

6.1 ATMOSPHERIC STABILITY

The method of computing stability by Pasquill's technique is given in chapter 3. The percent frequency of occurrence of Pasquill's stability classes is studied for every hour for all the months. The diurnal variation of the maximum occurring stability class is also studied for every month.

The diurnal variation of percent frequency of occurrence of each of the Pasquill's stability categories for every hour is presented in Figs. 6.1(a) and 6.1(b) for all the months. Here day time is considered as 0700 to 1800 hours and night-time as 1800 to 0700 hours. Highly stable conditions (F class) are observed during night-time and all classes of unstable conditions (A, B and C classes) are observed during day time in January. During the transition periods from night to day and day to night, one can notice the presence of neutral (D class) and slightly unstable (C class) conditions. Most of the day time all the three
Fig. 6.1(a). Diurnal variation of percent frequency of Pasquill's stability classes.
FIG. 6.1(b). DIURNAL VARIATION OF PERCENT FREQUENCY OF
PASQUILL'S STABILITY CLASSES
unstable classes are noticed although with variable frequencies. During night-time slightly stable (E class) conditions are in considerable frequency. The case of February is more or less same but for an increase of neutral conditions during day time and slightly stable conditions during night-time. One can see a systematic increase of neutral conditions from January to September, with a consequent decrease of highly unstable conditions during day time. There is a steady increase of slightly stable conditions from January to August. The presence of highly unstable conditions during October to April is mainly due to relatively clear skies which result in direct solar radiation to reach the surface of the earth which according to Pasquill's technique should lead to highly unstable conditions, provided the wind is not that high. The decrease of these unstable conditions from January onwards is because the wind gradually increases and also the sky becomes more and more cloudy month after month, both of which lead to less intense stabilities. The presence of neutral conditions mainly during day time is explained as due to the strong winds and to some extent overcast conditions. During night time the winds are very weak which allow the extreme cases to establish and prevent the so called neutral conditions, which require strong winds and overcast conditions. During the monsoonal months neutral conditions should have been in
considerable frequencies even during night-time but it results only in the increase of slightly stable conditions mainly because, although the skies are cloudy, winds are not strong enough to bring the highly stable conditions to neutrality. In general, all classes of unstable conditions are observed in the day time and stable conditions only at night-time.

It is of interest to see how each of these stabilities varies from month to month at a given time. Fig. 6.2 shows the monthly variation of Pasquill's stability classes at 1200 hours. One can see the systematic decrease of highly unstable conditions from January to July followed by an increase thereafter. The moderately unstable conditions although remaining constant till April, there is a systematic decrease from April onwards till August followed by an increase till October and a decrease thereafter. The cases of slightly unstable and neutral conditions are entirely different almost following the reversal in trend compared to that of highly unstable and moderately unstable conditions. In fact, the highly unstable and slightly unstable conditions show the reversal trend very exactly. The systematic increase of neutral conditions till August and the decrease thereafter is a noticeable feature. This time of 1200 hours is chosen for representing this variation mainly because all the four possible categories would appear.
FIG. 6.2. MONTHLY VARIATION OF PERCENT FREQUENCY OF
OF PASQUILL'S STABILITY CLASSES AT 1200 HOURS
It should be noted that whatever the circumstances would be according to the present criteria of Pasquill it is impossible to think of any stable conditions during day time and any unstable conditions in night-time. Now the reversal in trend among the possible trend is understandable.

Figs. 6.3(a) and 6.3(b) depict the percent frequency of maximum occurring stability at every hour for all the months. Undoubtedly category F is the maximum during the entire night-time in all the months except July and August, where E class dominates for a few hours in the early night. One can see the dominance of the highly unstable class to be the maximum in December followed by November, January, February, March and October. During the monsoonal months, it is never maximum at any time.

The very high frequency of highly stable conditions during night-time causes concern again. In fact, even during monsoonal months highly stable conditions are dominating during most of the night-time. These highly stable conditions do not allow the pollutants to get dispersed thereby resulting in higher concentrations slightly away from the source. The entire night-time conditions are really gloomy since neither the mixing height and ventilation coefficient nor the atmospheric stability helps in a good dispersal of pollutants. Although wind is included in driving all these parameters, a study of the wind roses separately
FIG. 6.3(a). DIURNAL VARIATION OF PERCENT FREQUENCY OF MAXIMUM
FIG. 6.3(b). DIURNAL VARIATION OF PERCENT FREQUENCY OF MAXIMUM OCCURRING PASQUILL'S STABILITY CLASSES
would make the picture clearer.

6.2 WIND ROSES

The six-hourly wind roses for 0000, 0600, 1200 and 1800 hours are represented in Figs. 6.4(a) to 6.4(f) for all the months.

From October to April, calm conditions dominate (frequency more than 70%) at 0000 and 0600 hours. At 1200 and 1800 hours, the frequency of calm conditions decreases and prevailing wind directions are northwesterlies and westerlies. During these times the wind speed is never greater than 30 km per hour except in April, when westerlies greater than 30 km per hour are some times experienced. In May, the calm conditions are around 50% at 0000 and 0006 hours and the winds are very weak. At 1200 and 1800 hours winds become stronger and northwesterlies prevail. From June to September, calm conditions are less than 30% at 0000 and 0600 hours and wind speeds in the range 21-30 km per hour are noticed. Also, they are generally from the northern sector only. At 1200 and 1800 hours calm conditions are never greater than 5%. Wind speeds greater than 30km per hour are observed in these months.

The night-time winds are very weak in most of the cases except during monsoonal months. The calm frequency is also high during night-time accounting for more than 75% in
FIG. 6.4(a) WIND ROSES FOR THE MONTHS OF JANUARY AND FEBRUARY
FIG. 6.4(b) WIND ROSES FOR THE MONTHS OF MARCH AND APRIL
FIG. 6.4(c) WIND ROSES FOR THE MONTHS OF MAY AND JUNE
FIG. 6.4(d) WIND ROSES FOR THE MONTHS OF JULY AND AUGUST
FIG. 6.4(e) WIND ROSES FOR THE MONTHS OF SEPTEMBER AND OCTOBER
FIG. 6.4(f) WIND ROSES FOR THE MONTHS OF NOVEMBER AND DECEMBER
most of the cases. This is a serious matter which one has to really worry about. Consistently the winds become stronger and stronger till the monsoonal months when they are the strongest. Another interesting feature is that during day time in no month does the wind blow from the eastern sector, while the westerly domination during day time in the non-monsoonal months may be explained to a large extent as due to the sea breeze phenomenon, the strong winds from the northwestern sector in the monsoonal months are due to the southwest monsoon. It is rather intriguing to note that during the southwest monsoon season the winds are mostly from the northwest even during night-time. This may be due to the fact that the monsoonal winds enter the coast as westerlies but on account of the presence of Western Ghats not far away from the city make the surface winds to deflect towards southeast in making the westerlies to become northwesterlies. In other words it is the orographic forcing which mainly may be responsible for the dominating wind direction to be northwesterly. The deflecting coriolis force also helps the westerlies to become northwesterlies. As far as the pollutant dispersal is concerned the monsoonal months seem to be more favourable from the point of view of strong winds. At night-time utmost caution must be exercised in view of the extremely high calm frequencies. It is evident that at night-time none of the conditions or parameters discussed so far seem to be favourable for the pollutant dispersal.
6.3 POLLUTION POTENTIAL INDICES

Fig. 6.5 shows the diurnal variation of the pollution potential indices for all the months. The highest value of pollution potential index (8) is observed in February at 1400 hours, which means that there would be a good dispersal of pollutants in this month. The maximum variation is seen in August and the minimum in May. During night-time, the index is always 3 in all the months except in July and August, when the value of 4 is also seen. Generally the index is greater than or equal to 6 in the afternoon hours. The systematic increase of the index from early morning hours to around maximum temperature epoch and the decrease thereafter is the consistent feature of the figure although on quite a few occasions the index is constant as for example in the case of night-time. Since this index takes into consideration all the possible parameters including stability this could be considered as a comprehensive index directly revealing the atmospheric abilities to disperse the pollutants. A minimum index of 6 is suggested for a good dispersal of pollutants. However, 6 number as the permissible limit has no experimental sanctity. It should be noted here that the extreme index of 9 does not appear anywhere mainly because of the coastal characteristics. Since this index takes into consideration all the possible
FIG. 6.5. DIURNAL VARIATION OF POLLUTION POTENTIAL INDICES
parameters including stability this could be considered as a comprehensive index directly revealing the atmospheric abilities to disperse the pollutants. The night-time situation is very grim as has been noted in the earlier cases, and as such utmost precautions must be taken to bring down the concentration of pollutants.