EVALUATION OF ATMOSPHERIC CONDITION OF GANDHI NAGAR, GUJARAT

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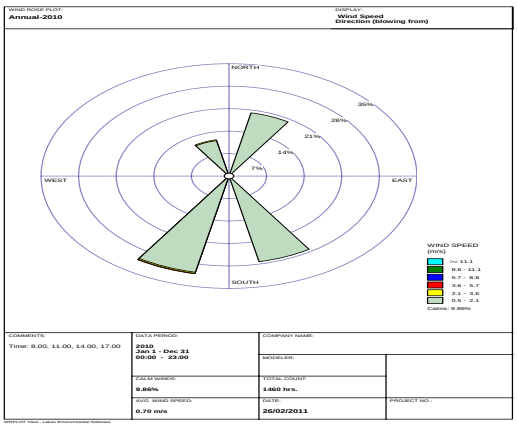
***ABSTRACT*: Understanding of the atmospheric conditions of a particular area is very important to assess the dispersion ability of pollutants from any source of air pollution. The wind rose diagrams are the important tools to represent graphically the percentage frequency distribution of wind speed and direction for a given period & location. Similarly, the atmospheric stability is an important parameter which determines the ability of pollutants to disperse in the atmosphere. These atmospheric stabilities further classified under six categories starting from category A to category F. The atmospheric category A represents highly unstable atmosphere followed by B as unstable , C as slightly unstable , D as neutral , E as stable and F as highly stable. Highly unstable atmosphere is good for dispersion of air pollutants where as highly stable is known to have poor dispersion ability. An effort has been made in the present research work to prepare monthly, seasonal and annual wind roses and stability roses with a view to analyze the atmospheric conditions of Gandhi Nagar, Gujarat.**

APPLICATIONS OF WIND ROSES:

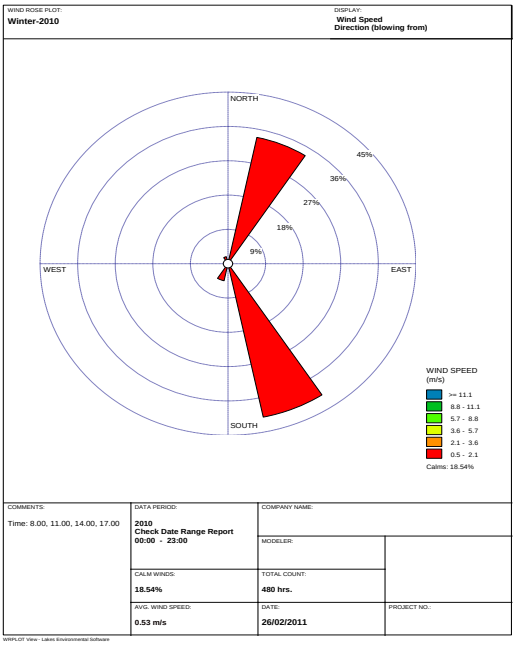
1. Urban Planning
2. Siting of industrial locations including chimney & other air polluting source
3. Industrial zoning & industrial estate planning
4. Air pollution modeling.
5. Disaster Management
6. Street layout
7. Ventilation of urban, industrial and housing
8. Environmental Impact Assessment study.
9. Oceanography
10. Wind Energy
11. Agriculture Engineering
12. Ambient Air Monitoring
13. Noise Impact Modeling

Similarly, the atmospheric stability roses represent graphically the % frequency distribution of different stability classes in different directions for a specified period and location. The application of stability roses are mainly in the air dispersion modeling which predict ground level air pollutant concentrations for a given air polluting source under different stability conditions.

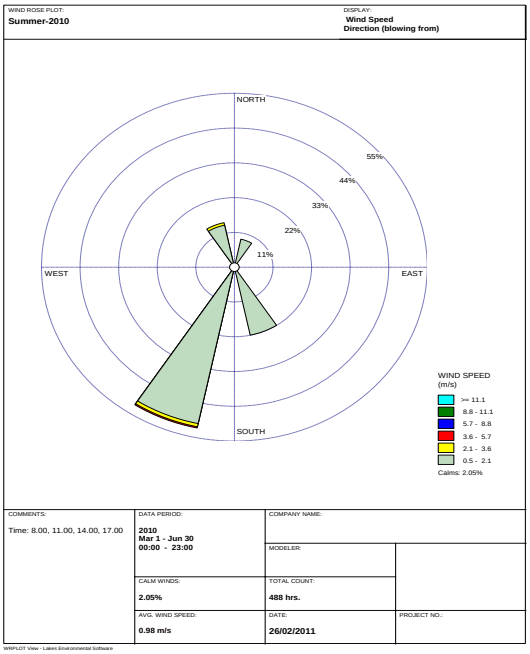
WIND ROSES DIAGRAMS AND THEIR ANALYSIS:



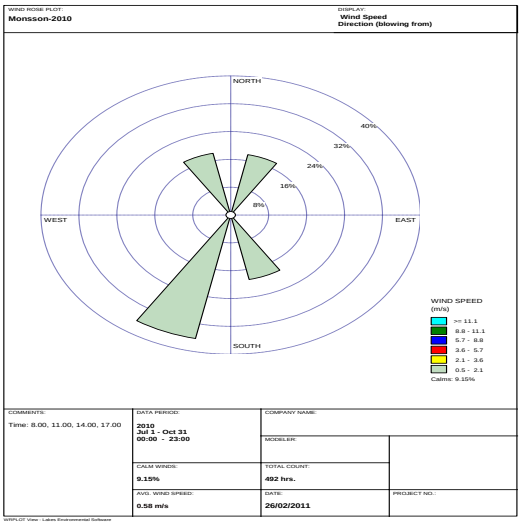
The Annual wind roses for the Year -2010 as per figure reveals that the predominant wind direction is SSW with 32% of the times, with an average wind speed of 0.739 m/s, followed by SSE direction with 27 % frequency distribution with an average wind speed of 0.550m/s., and NNE (20%) & NNW (11%) with an average wind speed of 0.665 & 0.743 m/s respectively.



Similarly, the wind roses for winter season- 2010 as per figure reveals that the predominant wind direction is SSE with 41 % of the times, with an average wind speed of 0.602 m/s, followed by NNE direction with 32 % frequency distribution with an average wind speed of 0.560 m/s.



Moreover, the wind roses for summer - 2010 as per figure reveals that the predominant wind direction is SSW with 51% of the times, with an average wind speed of 1.181 m/s, followed by SSE direction with 22 % frequency distribution with an average wind speed of 0.575m/s., and NNW (15%) & NNE (8%) with an average wind speed of 1.103 & 0.881 m/s respectively.



The wind roses for the Monsoon - 2010 as per figure reveals that the predominant wind direction is SSW with 36% of the times, with an average wind speed of 0.619 m/s, followed by SSE direction with 20 % frequency distribution with an average wind speed of 0.473m/s., and NNW (19%) & NNE (8%) with an average wind speed of 0.748 & 0.554 m/s respectively.

The analysis of monthly wind roses tends to indicate the predominant wind direction as SSW followed by SSE. It also tends to indicate the wind speed on an average is much below 2.0 m/s which would show low wind speeds during all the months for Gandhinagar. The comparison of wind speeds would also tends to indicate that during all the months the wind speeds are much less than 1.0 m/s except for the summer months (April to June) where the wind speeds are more than 1.0 m/s.

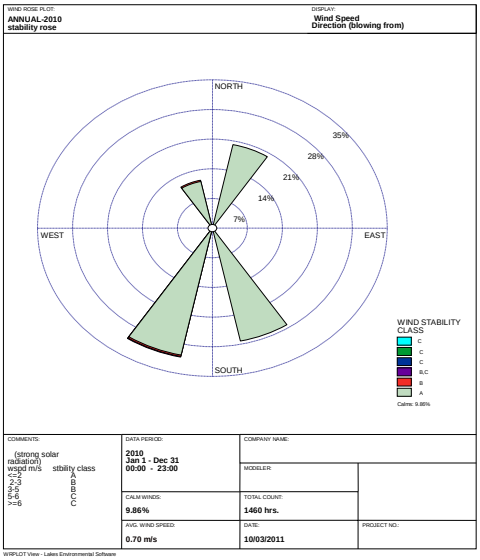
The analysis of seasonal wind roses would show that the predominant wind direction is SSW during summer & monsoon whereas SSE during winter. During summer season the wind speeds are marginally greater than 1.0 m/s whereas during winter and monsoon season the wind speeds are quite low and indicate significantly less than 1.0 m/s.

The analysis of Annual wind rose reveals the fact the predominant wind direction is SSW followed by SSE, NNE & NNW and in all the cases the average wind speeds are less than 1.0 m/s which can be classified as low wind speeds during 2010 for Gandhinagar area. The calm conditions during 2010 are of the order of around 10%.

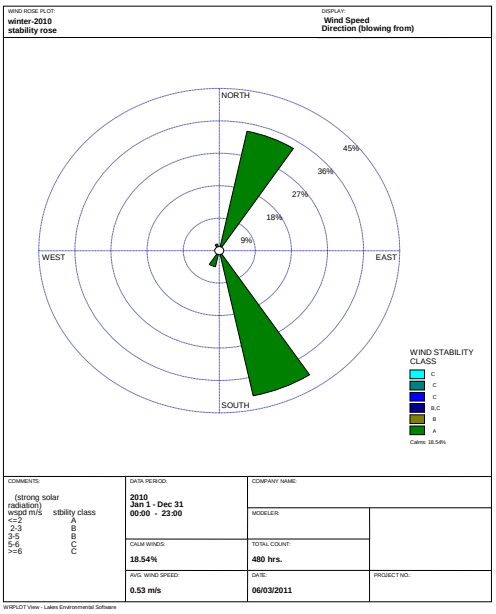
ATMOSPHERIC STABILITY ROSES AND THEIR ANALYSIS:-

An effort has also been made to prepare Atmospheric stability roses with a view to assess the dispersion ability of the air pollutants in the atmosphere.

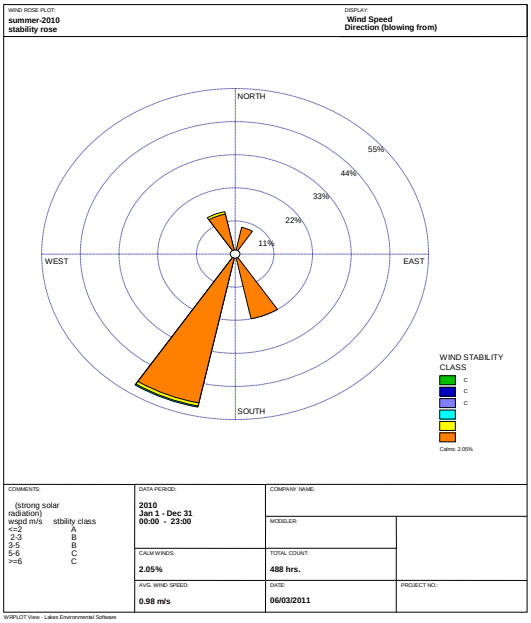
The monthly, seasonal & annual stability roses had been prepared and shown in figures, the details of which are even here under.



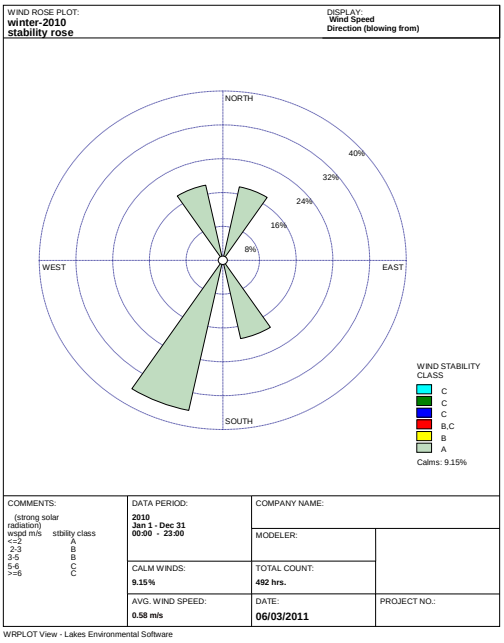
Similarly, the stability rose for the month of Annual-2010 as per figure shows atmospheric stability as A as predominant with 87% of occurrence with predominant wind direction SSW followed by SSE, NNE & NNW.



Similarly, the stability rose for the Season winter of 2010 as per figure shows atmospheric stability as A as predominant with 78% of occurrence with predominant wind direction SSE followed by NNE & SSE.



The stability rose for the Season Summer of 2010 as per figure shows atmospheric stability as A as predominant with 97% of occurrence with predominant wind direction SSW followed by SSE, NNW & NNE.



Similarly, the stability rose for the Season Monsoon of 2010 as per figure 33 shows atmospheric stability as A as predominant with 90 % of occurrence with predominant wind direction SSW followed by SSE, NNW & NNE.

The atmospheric conditions of Gandhi Nagar tends to indicate that the plume rise from any air polluting industry would relatively be higher resulting into less ground level concentration of air. This fact has been demonstrated in the research work being carried out by the author for Vehicular air pollution of Gandhi Nagar city. Moreover, according to **Pasquill**, the amount of turbulence in the ambient air has a major effect upon the rise and dispersion of air pollutant plumes. The amount of turbulence can be categorized into defined increments or "stability classes". According to him class A denotes the most unstable or most turbulent conditions and Class F denotes the most stable or least turbulent conditions.

Acknowledgment
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References and notes:-

[1] "Air Pollution Meteorology", U.S.Dept. of Health, Education and Welfare, Washington DC, 1971.
[2] Magill, P.L., F.R. Holden and C. Acklay, "Air Pollution Handbook", McGraw-Hill Book Co., Inc., New York, 1956.
[3] Meteorological and Environmental System, Catalogue, CLIMATE Instruments Company, USA.
[4] Pasquill, F., "Atmospheric Diffusion", Van Nostrand and Co. Inc. USA, 1962.
[5] Perkins, H.C., "Air Pollution", McGraw-Hill Kogakusha Ltd., Tokyo, 1974.
[6] Stern, A.C. (Ed.), "Air Pollution", vol. 3, 2nd edn., Academic Press, New York, 1968.
[7] Strauss, W. (Ed.), "Air Pollution" Part-III, Wiley-Interscience, New York, 1978.