Jr. of Industrial Pollution Control 20 (1) (2004) pp. 53-58

WEIBULL PARAMETERS FOR WIND SPEED DISTRIBUTION IN SALEM CITY

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Key words : Weibull distribution - Wind power- Pollution dispersion

ABSTRACT

Emission dispersion occurs in the direction of the wind. The wind has a diluting effect on the flue gas concentrations behind a stack, which is approximately proportional to its horizontal velocity. The exponential increase of the wind velocity with altitude favours the dispersions of the flue gases from high stacks. As an energy source, the natural wind is extremely variable. To model wind features of Salem: The Weibull distribution has been chosen. Also available wind energy is estimated.

INTRODUCTION

Wind speed frequency distribution is an important parameter for predicting the energy output of a wind energy conversion system. The Weibull function is a two parameter function, namely shape parameter k and scale parameter c. There are several methods available in the literature for the calculation of these two parameters as stated by Stevens and Smulders (1979). In this study, the shape parameter k and scale parameter c are calculated by (1) Frequency method (2) Maximum likely hood method. In this paper, alternate date of 6 time average wind data for the period April 2001-March 2002 are used.

Study area

The Salem city is situated in the central part of the state lies about 330 kms southwest of Chennai. The city skirted on all meteorological sides that is north, south, east and west buyinter connecting hills of the Eastern Ghats to Western Ghats. The city lies on the latitude of 12^0,15′ and longitude of 78^0 10′. The city experiences maximum temperature of 42^0C and a mimimum of 25^0C during summer and experiences a maximum of 30^0C and minimum of 20^0C during winter. Ambient air quality has been monitored at Salem Sowdeswari College in Salem city by Tamil Nadu Pollution Control Board under National Air Quality Monitory Programme (NAMP) since July 1996. This monitory station comes under the category of industrial mixed zone. Wind speed data studies in this paper is based on a series of measurements taken (4 hour basis) on every Mondays, Wednesdays and Fridays through all months of the year 2001- 2002.

Weibull distribution function

The Weibull distribution function which is a two-parameter function is expressed mathematically as follows :

$$f(V) = \frac{K}{C}\left(\frac{V}{C}\right)^{k-1} \exp\left[-\left(\frac{V}{C}\right)^{k}\right] \qquad (1)$$

Where k is the scale parameter, c is the shape parameter, and v is the wind speed. The cumulative distribution function is obtained by integrating equation (1) and takes form :

$$F(V) = 1 - \exp\left[\left(\frac{V}{C}\right)^{k}\right] \qquad (2)$$

The mean of the Weibull distribution that is the mean wind speed , is expressed in terms of the gamma function and is given by:

$$\bar{V} = C\Gamma\left(1 + \frac{1}{k}\right) \qquad (3)$$

Where v is expressed mean wind speed and Γ is the gamma function.

Wind

An empirical formula relating wind a speed to height in the friction layer, that zone of air beneath 700 to 1000 m, is -

$$\left[\frac{V}{V_0}\right] \left[\frac{Z}{Z_0}\right]^{N}$$

Where v= wind speed at height z m/s

Vo = wind speed at anemometer level zo, m/s

N = co efficient, approximately 1/7. The choice of the exponent n in the power law equation is a function of atmospheric stability, wind speed, the roughness length of the upwind terrain and the site elevation.

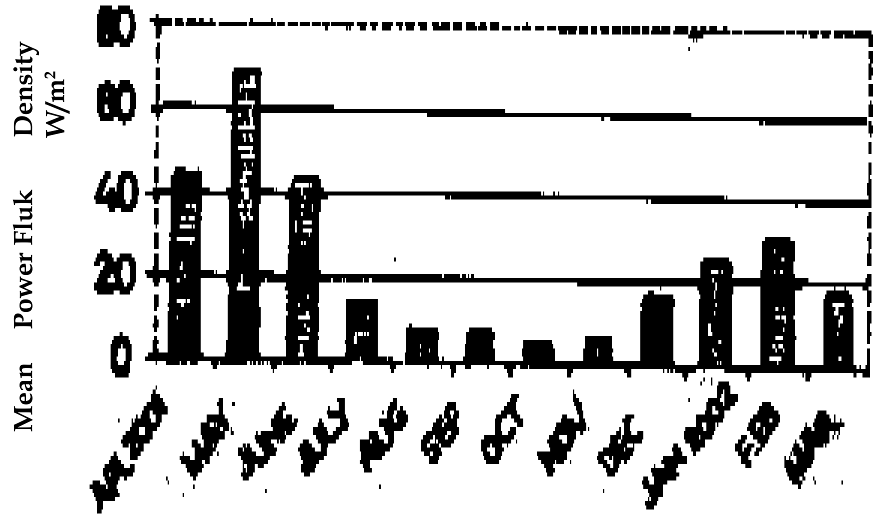

Fig. 1 - Monthly variation of wind power density

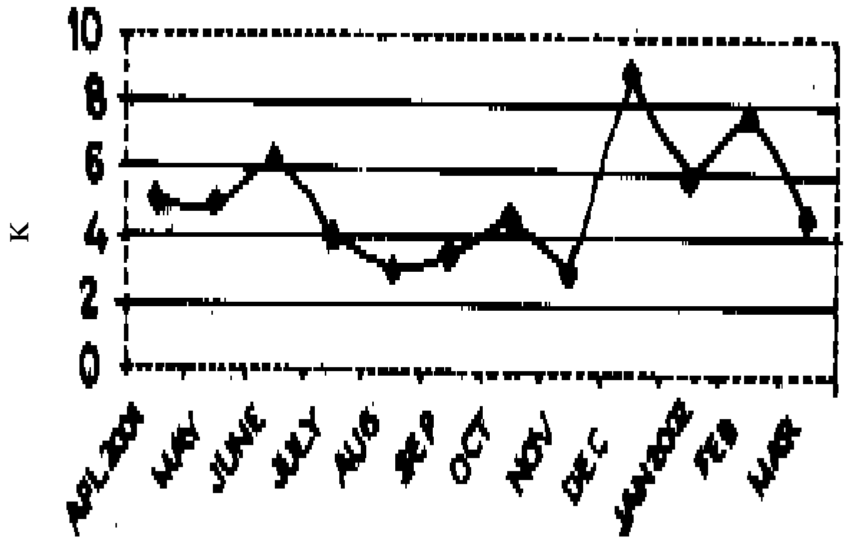

Fig. 2 - Monthly variation of the Weibull k value

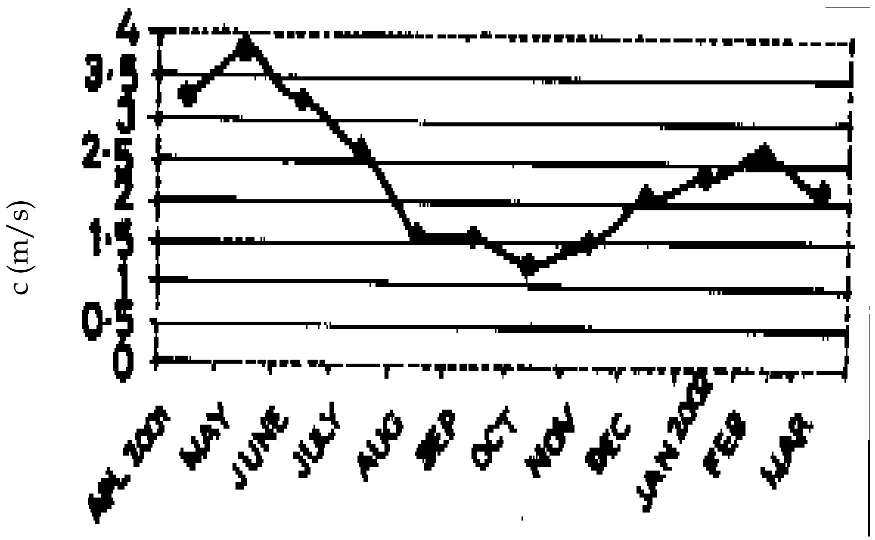

Fig. 3 - Monthly variation of the Weibull c value

TABLE -1
Weibull Parameter
Station : Salem, Method : Frequency Method

Sr. No.	Month	k	c (m/s) 10 m a.g.l.	n
1.	April- 2001	1.0571	5.4986	0.1073
2.	May	1.5116	3.6743	0.1398
3.	June	1.3864	3.1520	0.1428
4.	July	4.0466	2.6134	0.1564
5.	August	0.6165	0.9886	0.1727
6.	September	0.8692	1.1631	0.2584
7.	October	0.9373	0.8210	0.2440
8.	November	0.2947	0.5133	0.3160
9.	December	0.9448	1.5408	0.2192
10.	January-02	0.8332	2.4665	0.1778
11.	Febueary-02	0.8556	2.5548	0.1747
12.	March-02	0l7551	0.9350	0.2632

TABLE -2
Weibull Parameter
Station : Salem, Method : Maximum likehood Method

Sr. No.	Month	Av. Wind Velocity m/s	k	c (m/s) a.g.l.	n	Wind Velocity at 100 m height a.g.l.
1.	April-2001	2.95	5.0467	3.2495	0.1536	4.2017
2.	May	3.51	4.9083	3.7978	0.1398	4.8429
3.	June	2.91	6.2790	3.2195	0.1544	4.1595
4.	July	1.94	4.0466	2.6134	0.1727	2.8892
5.	August	1.41	3.0215	1.5671	0.2177	2.3316
6.	September	1.38	3.4941	1.5474	0.2189	2.2944
7.	October	1.12	4.5830	1.2318	0.2389	1.9452
8.	November	1.30	3.0281	1.4714	0.2233	2.1876
9.	December	1.90	8.9593	2.0786	0.1929	2.9696
10.	January-02	2.25	5.8633	2.3088	0.1836	3.4419
11.	Febueary-02	2.46	7.7020	2.6013	0.1732	3.6779
12.	March-02	1.98	4.6899	2.1418	0.1903	3 . 0 7 7 6

TABLE -3
Wind Power Potential (Maximum Likelihood Method)

Sr. No.	Month	Mean Annual wind speed at 10 m a.g.l.	Mean Annual wind speed at 100m a.g.l.	Mean Power Flux density w/m2	Mean power from turbine blade of 120 M dia in kw (100 m.a.g.l.
1.	April- 2001	2.95	4.20	45.41	179.71
2.	May	3.51	4.84	69.50	275.11
3.	June	2.91	4.15	43.81	173.43
4.	July	1.94	2.88	14.64	57.96
5.	August	1.41	2.33	7.75	30.69
6.	September	1.38	2.29	7.36	29.13
7.	October	1.12	1.94	4.47	17.71
8.	November	1.30	2.18	6.35	25.13
9.	December	1.90	2.97	16.06	63.37
10.	Jan-2002	2.25	3.44	24.95	98.78
11.	Feb- 2002	2.56	3.68	30.54	120.93
12.	March-2002	1.98	3.08	17.91	70.90

CONCLUSION

Wind data covered in this paper is pertains for the year 2001-2002 of Salem city. For wind resource estimation the Weibull parameters c and k are derived for the city. The most generous months supplying wind power in Salem city is April, May and June. Smaller wind energy conversion systems are only suitable for the wind condition.

In air pollution concentration prediction models speed (uniform wind) at the height of release of pollutant is an important input to the model, The commonly used power law describes the wind speed profile with height. The exponent of the power law 'n' is now derived for industrial mixed zone of Salem city based on the above wind data and hence ground level concentration (GLC) of air pollutant can be estimated realistically.

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News -

A gift of power for rural India

BP Solar USA, one of the world's leading solar power companies, is donating over US$ 1 million worth of solar modules to the Based Agency for Sustainable Energy (BASE), a UNEP Collaborating Centre, for use in areas of India where over 60% of the population is wihtout electricity. The systems, totalling 635 kilowats, will power water pumps, lights and telecommunuication services such as cybercafes.
Virginia Sonntag- O' Brien, BASE Managaing Direcotr, said: "Lack of access to reliable and affordable energy is one of the main obstacles to economic development in developing countries. These solar photovolatic modules ... will not only help overcome this hurdle, but will do so in a clean cost insurers more than US$ 3 billion.
In conjenction with the report, the Climate Change Working Group launched a briefing document, aimed at the Chief excutive Officers of large cooperation highlighting the opportunities and challanges of emission trading (see Books and Reports, below).
Munich Re's full findings on the economic and isured costs of weather related natural catastrophes in 2003 were expected to be published at the ned of the year.
(UNEP I & E Jan. 2004).