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DESIGN AND DEVELOPMENT OF SOFTWARE PACKAGE FOR THE EVALUATION OF WATER VAPOUR CONCENTRATION

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ABSTRACT: *A computer software package was designed and developed to evaluate water vapor concentration in the lower atmosphere using Visual basic programming. The package was developed for Garcia Muller model. The water vapor concentration absorbs long wave terrestrial's radiation and insulating energy transfer through the atmosphere. The performance of the package was excellent when used to evaluate upper air data for Lagos station (Lat 6^0 32' E, Longitude 3^0. 28' E), Kano station (Lat 12^0 00N, long 8^0 31'E), Minana station (Lat 9^0 39' N, Long 6^0, 32' E) and Maiduguri station (Lat 11^0 53' N, Long 13^0 16' E). The size of the package is 1.08KB. The results obtained were compared with results gotten from other location and was found to be in agreement. This package will save researchers much time since it can evalvate as many data.*

KEYWORDS: *Software, Water vapour, Terrestrial radiation, Energy transfer, Propagation*

INTRODUCTION

Propagation is the transfer of energy from one point to another point without the transfer of the matter. This transfer takes place between two medium which result to change with time in the spatial in a non-static field in that medium. All radio path travels through the atmosphere during propagation and it is influence by refractive index, atmospheric gas and hydrometeors present in the atmosphere. Water vapour is one of the variable constituent which contains about 3% in the atmosphere. The absorption of the electromagnetic waves in the atmosphere is of great importance in communication system. The radio-waves propagation in the troposphere which extends from the ground level to the a height of 10-15Km above the sea-level is being affected by variable concentration of water vapour either by refracted or scattered by variation in the radio refractive index 'n' which is either caused by variation in pressure p(bm), temperature T(K) and water vpour pressure e(mb) according to the formula

$$\mu = (n-1) \times 10^6 = \frac{77.6P}{T} + \frac{3.73\times10^5 e}{T^2}$$

Where μ = refractivity

The refractive index at the earth's surface is about 1.0003. It falls to unity at a greater height. The macroscopic structure of the troposphere varies much more rapidly vertically than horizontally. Hence, the troposphere is vertically stratified. Considering the equilibrium stratification of the atmosphere at rest with no heat sources, the decrease in pressure P with height is balanced by gravity by

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$$\frac{\partial P}{\partial z} = -gp = \frac{gP}{RT}$$

The troposphere means "region of mixing" (Lal D.S. 1991). This lowermost layer of the atmosphere is about 14Km above the sea-level. At the upper limit of the troposphere, various types of clouds, thunder-storm, cyclones and anticyclones occurs because of the concentration of water vapour and aerosols in it. There is a decrease of temperature with increasing elevation at a mean lapse rate of about 6.5. Water vapor concentration in the atmosphere has an adverse effect in communication system, hence the need to evaluate the amount of water vapor density using the Gracia Muller model. The model uses the ground data to obtain the water vapor density for kour in French Guyanna using the equation:

$$\text{Pw} = \frac{1320.65}{273.15 + t} \times U \times 10exp\frac{7.5 \times t}{237.3 + t}g/m$$

Where

P_w=water vapor concentration in g/m^3

U=relative humidity in %

T=temperature in Celsius

METHODOLOGY

On clicking on the visual basic, a new project dialog box is displaced; it has many form of application such as standard exe, Active × OLL, Active × control. Clicking the standard exe and clicking the open button, form and tool box which contains the controls are displayed. The new project dialog box is shown in figure 1.0

Controls are object that can be placed on a form to enable the designer to design his work effectively in the Microsoft visual basic window. This control has properties such as caption, name, visible, enable and colour. The control is event driven and they can be activated by coding. The designer determines the choice of event to be carried out by the control. The form is the interactive surface of the visual basic window. Form is an interface where every design work is carried out. The forms are held by a project name, two or more forms can be in one project. These forms are found on the water vapor concentration package. The design of this package has form frurmain, frmtemprh and frmview. This forms has buttons and each buttons is coded to achieve a predefined task. The frmmain is shown in figure 1.1 with the capture "Welcome to living water". The frmmain has two buttons; Data entry and Compute result. On clicking Data entry dialogbox, then enter your data form will be displayed. The form has buttons such as temperature, relative humidity, accept data and cancel button, this is shown in figure 1.2. On this form, the data or values are input. By clicking the accept data button, the form of frmview result is displayed with dialog boxes of file,print, view result, save result and close. On frmview, the computed result can be saved, viewed and printed. Calculated result is displayed as shown in figure 1.3.

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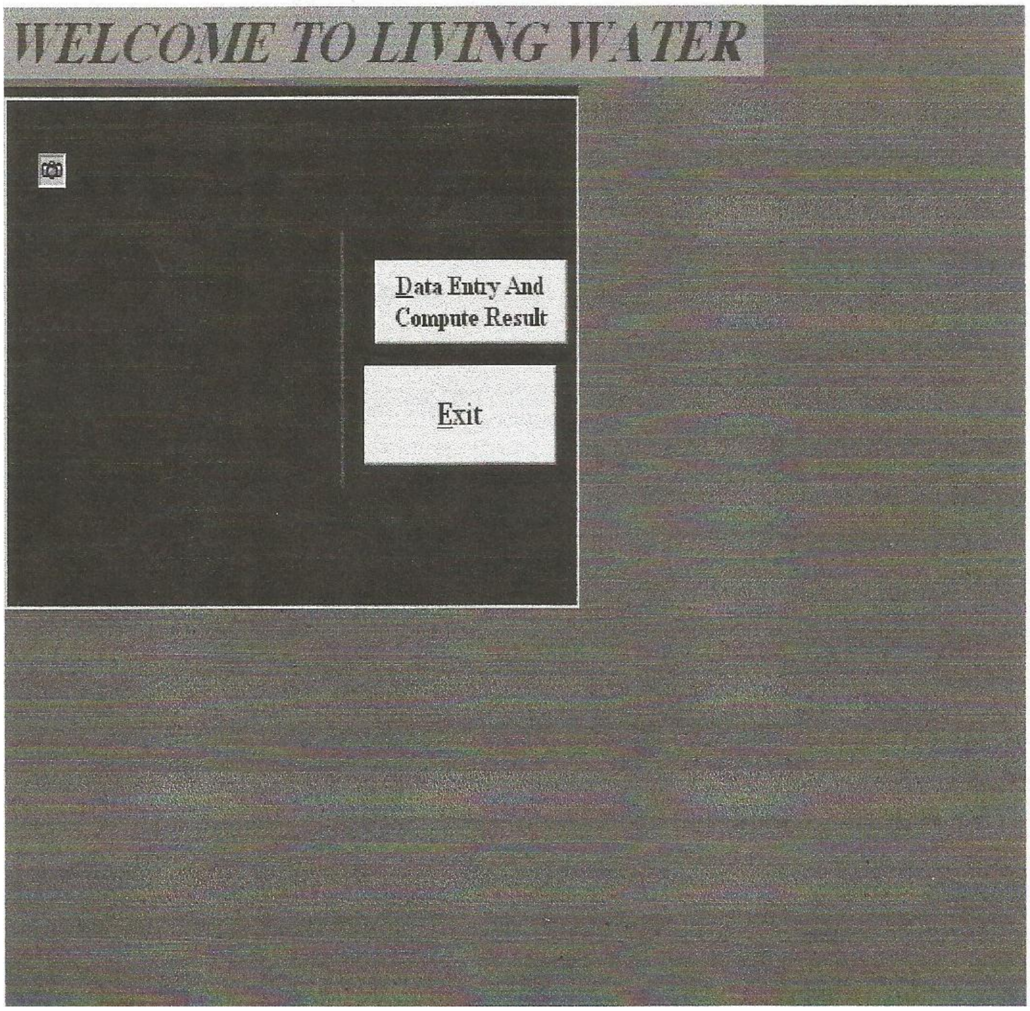

Figure 1.1: FrmMain

Table 1.1 Computational data of water vapour concentration for Kano

Temp (°C)	Rh(%)	Water vapour density (kg/m^3)
-33.2	17	-06
-31.9	22	-08
-30.0	29	-09
-32.4	37	-15
-31.2	38	-07
-30.9	26	0.7
-31.1	21	6.06
-31.6	11	0.08
32.0	35	0.13
33.1	43	0.19

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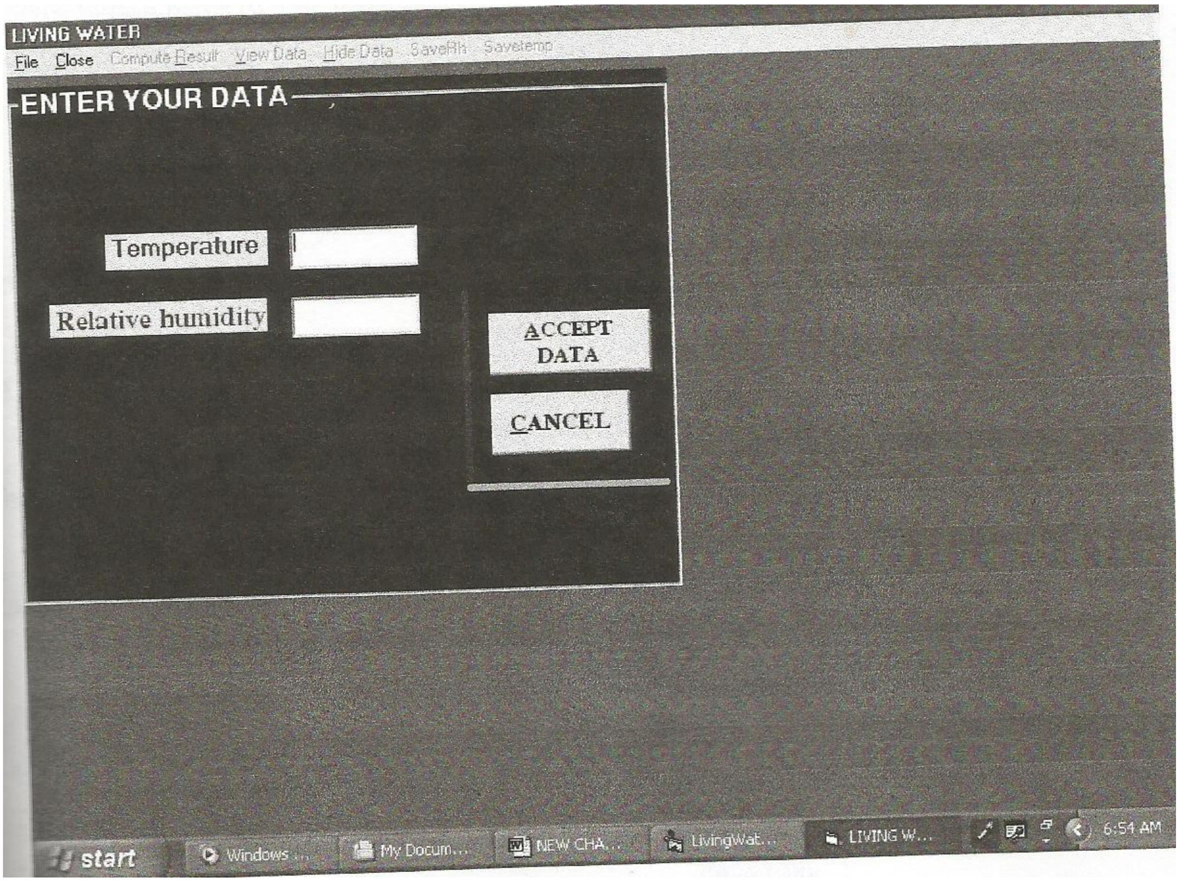

Figure 1.2:Frmtemprh

Table 1.2 Computational data of water vapour concentration for Lagos

Temp (^{o}c)	Rh(%)	Water vapour density (kg/m^3)
-32.2	14	.0 5
-31.7	16	.06
-31.4	18	.07
-30.0	30	.13
-32.0	37	.15
-33.1	39	.15
-34.0	50	.18
-29.1	43	.13
-31.5	30	.12
-31.4	17	.07
-31.1	24	.10

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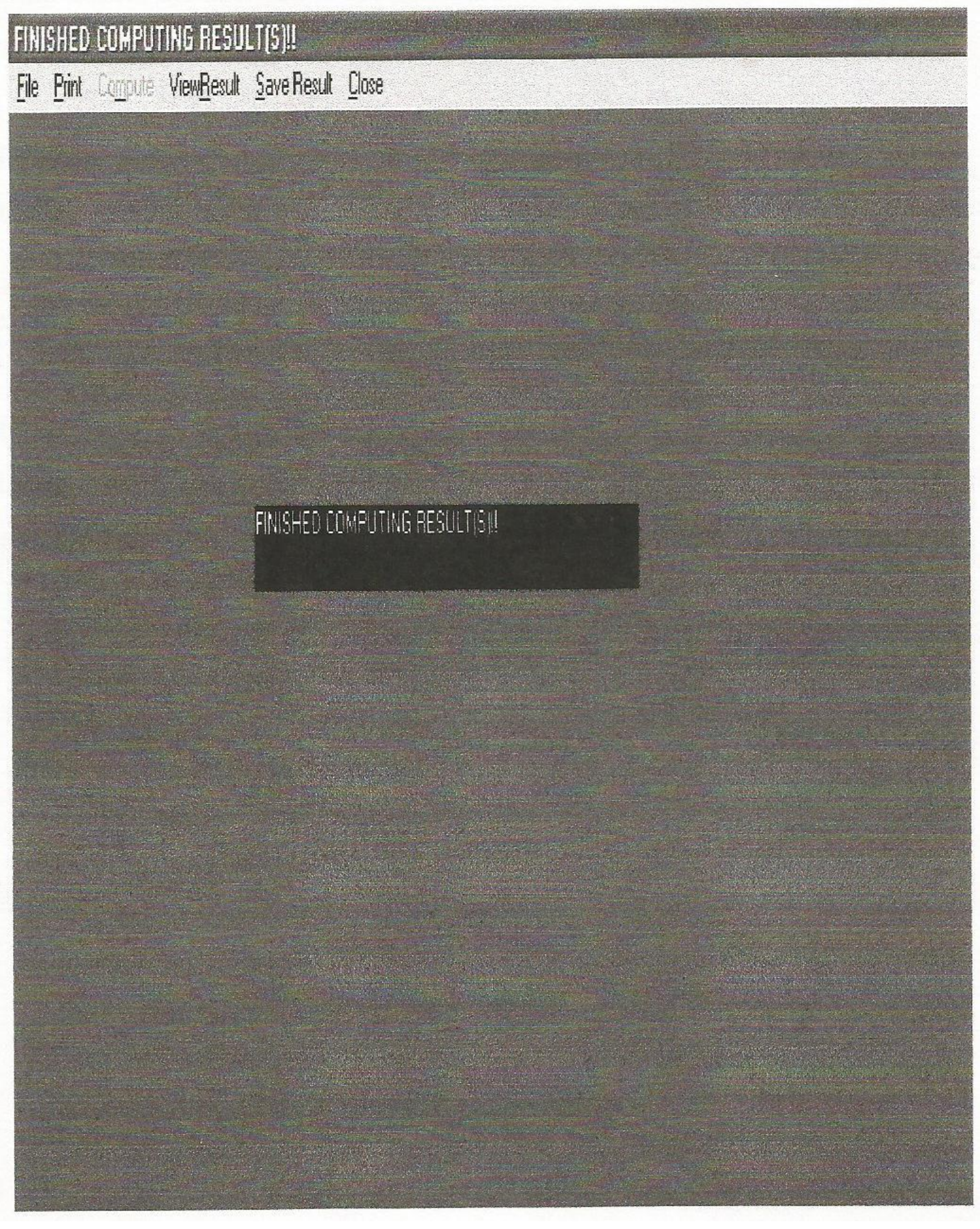

Figure 1.3:FrmView

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Table 1.3 Computational data of water vapour concentration for Minna

Temp (°C)	Rh(%)	Water vapour density (kg/m^3)
-32.6	31	.11
-30.2	31	.14
-31.6	22	.08
-31.4	31	.12
-30.6	48	.2
-31.5	36	.14
-31.9	49	.18
-33	55	.2
30.4	54	18.48
32.2	7	.02
-30.4	35	.11
-29.5	40.2	.16

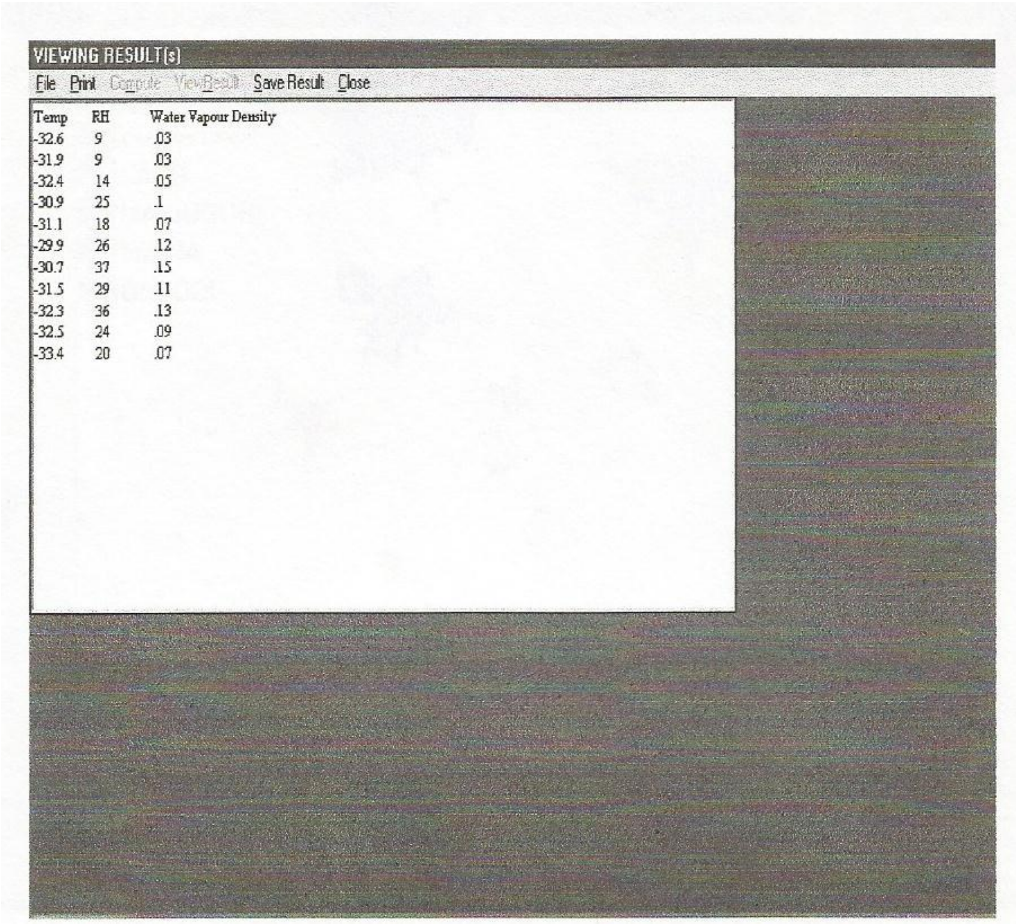

Figure 1.4 Calculated result

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Table 1.4 Computational data of water vapour concentration for Maiduguri

Temp (^{0}C)	Rh(%)	Water vapour density (kg/m^3)
-32.6	9	0.03
-31.9	9	0.03
-32.4	14	0.10
-30.9	25	0.07
-31.1	18	0.12
-29.9	26	0.15
-30.7	37	0.11
-30.5	29	0.13
-32.3	36	0.09
-33.4	24	0.7
-32.3	30	0.5

RESULT AND DISCUSSION

Results

The results obtained for water vapour concentration are shown in table 1.1 to 1.4 for Kano, Lagos, Minna and Maiduguri. The results are illustrated with graph by plotting temperature T and relative humidity RH against water vapour concentration as shown in figure 1.0-1.3(a-b).

DISCUSSION

The table 1.1 to 1.4 shows the result obtained for water vapour concentration at Kano, Lagos, Minna and Maiduguri. The Minna region has the highest average monthly value of 18.48g/m^3 while Maiduguri has the lowest value of 0.15g/m^3. In Nigeria the dry season begins from October to February and the rainy season commences in March to September for the Southern region. But for the Northern region, dry season begins in September to March and rainy season starts from April to August. In the month of February when there is a very high temperature of about 32.3°C, the water vapour density increases to 18.48g/m^3. And in the month of June when the temperature decreases to -30.7°C, the value of water vapour decreases to 0.15g/m^3. This variation of water vapour density can be attributed to the change in temperature. The higher the temperature and relative humidity of a place, the higher the value of water vapour density as the plotted graphs in figure 1.0 to 1.3 (a-b) show. The graph has a zig-zag pattern which implies that water vapour concentration varies with temperature and relative humidity of place or region as Garcia Muller model comfirms.

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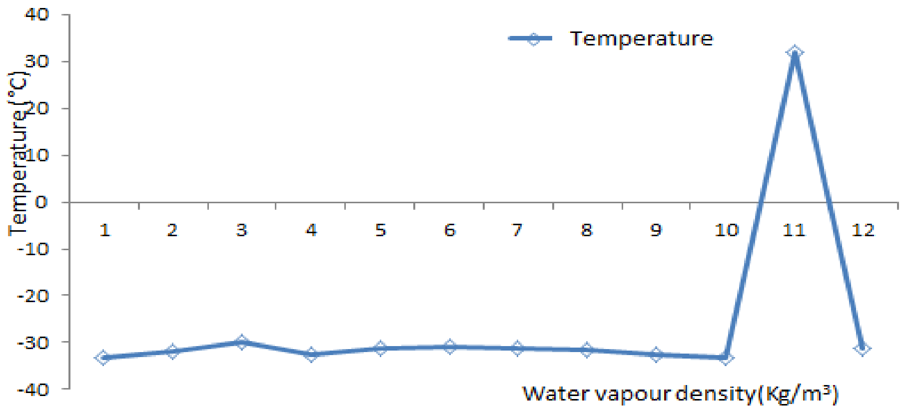

Figure 1.0 a Variation of temperature against water vapour density

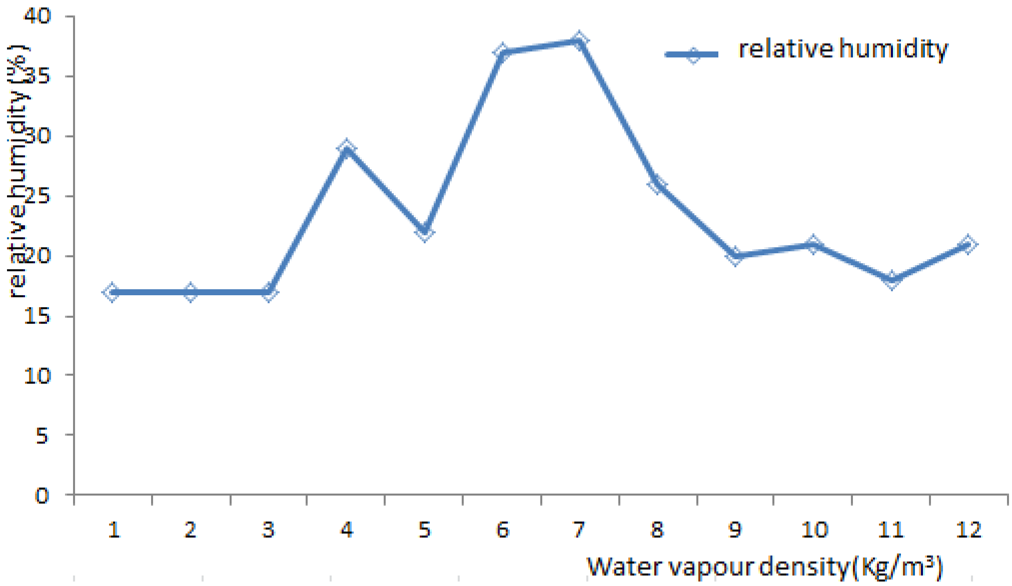

Figure 1.0 a Variation of relative humidity against water vapour density

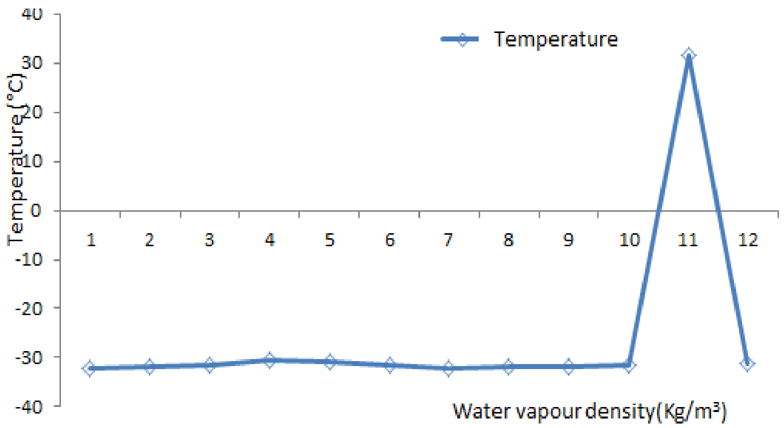

Figure 1.1 a Variation of temperature against water vapour density

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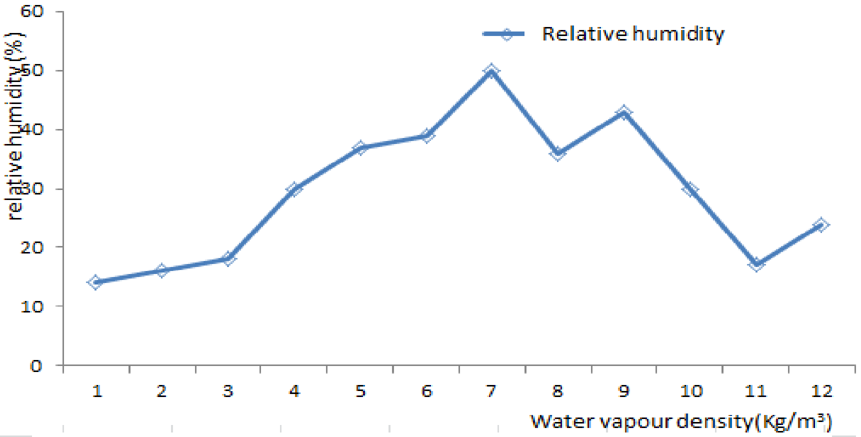

Figure 1.1 b Variation of relative humidity against water vapour density

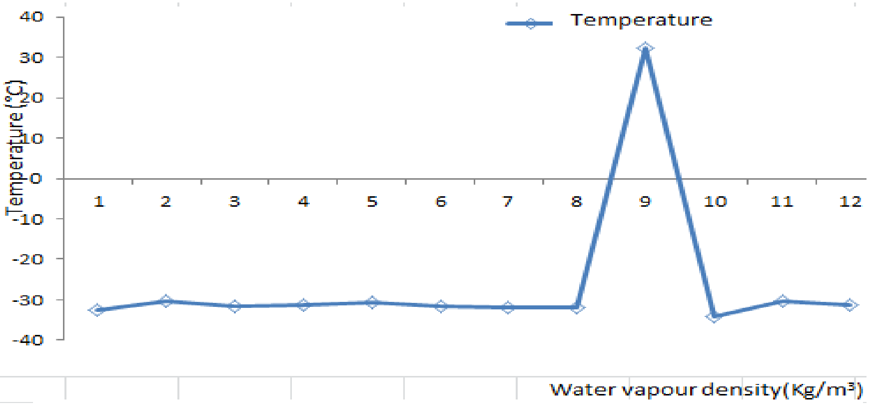

Figure 1.2 a Variation of temperature against water vapour density

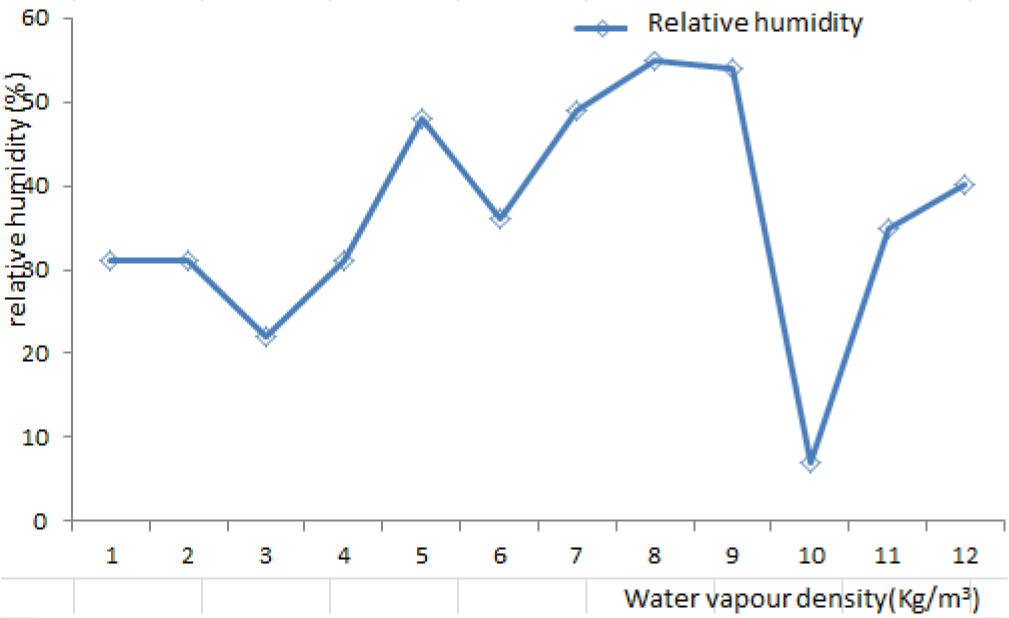

Figure 1.2 b Variation of relative humidity against water vapour density

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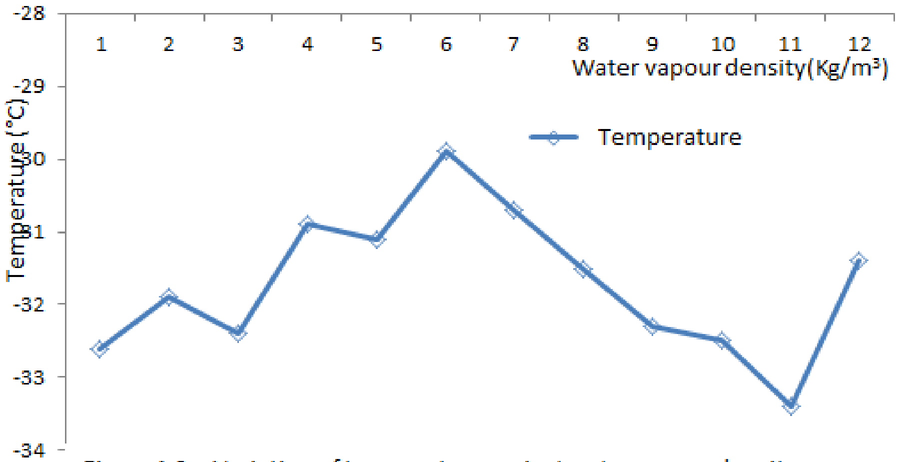

Figure 1.3 a Variation of temperature against water vapour density

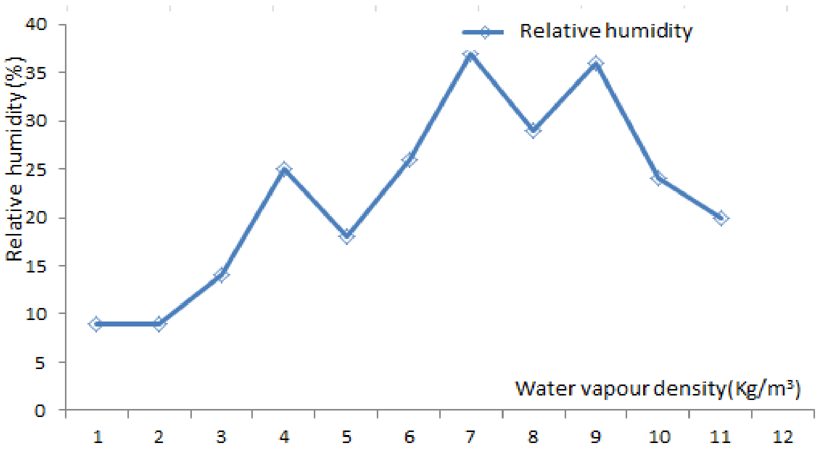

Figure 1.3b Variation of relative humidity against water vapour density

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