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- Artificial Neural Network
- Citrus Fruit Species
- A Strategic Analysis

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Contents of the Volume

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Table of Contents
v. From the Chief Editor's Desk
vi. Research and Review Papers

1. Physico Chemical Analysis of River Jhelum (Kashmir) *1-3*
2. Mosquito Repellent Activity of Phytochemical Extracts From Peels of Citrus Fruit Species. *5-8*
3. Estimation of Tropospheric Refractivity with Artificial Neural Network at Minna, Nigeria *9-14*
4. India's Readiness on ROHS Directives: A Strategic Analysis *15-26*

vii. Auxiliary Memberships
viii. Process of Submission of Research Paper
ix. Preferred Author Guidelines
x. Index

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Physico-Chemical Analysis of River Jhelum (Kashmir)

By M. Y. Khan, Mir Shabeer, Imtiyaz A. Raja & Nazir A. Wani

S. P. College Srinagar

Abstract - The present study was conducted for the time period of one year (April, 2009- March 2010) with an aim to find out the physico-chemical nature of water at different sites of River Jehlum in order to access the physical properties and chemical nature of its water and the impact of site/s on their concentration. Three sites were selected for the study purpose and the samples were collected on monthly bases. The samples thus collected were processed for the detection of metals with their relative concentrations following the standard methods. It was observed that the concentration of these metals was varying with respect to the collection sites, so was the case with respect to its physical nature. Also it was observed that there was a difference in concentration of these elements at different sites when compared among them selves. The data of physico-chemical nature of water of river Jehlum obtained during the study have been mentioned in Table 1. Furthermore it was also observed that concentration of some of these elements was more than the permissible limits as recommended by WHO which could have a definite impact on life. Keeping the same in view the present study was taken into consideration in which an attempt was made to access the water quality of River Jehlum and it is believed that this study would be helpful in formulating control strategy in near future.

Keywords : *Water, Physico-chemical, Concentration, River Jehlum.*

GJSFR-E Classification : *FOR Code: 050299*

PHYSICO-CHEMICAL ANALYSIS OF RIVER JHELUM KASHMIR

Strictly as per the compliance and regulations of :

Physico-Chemical Analysis of River Jhelum (Kashmir)

M. Y. Khan [α], Mir Shabeer [σ], Imtiyaz A. Raja [ρ] & Nazir A. Wani [ω]

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Keywords : Water, Physico-chemical, Concentration, River Jehlum.

I. Introduction

Water is one of the most important components of life and life without it is impossible. However due to increasing anti-environmental human activities and some natural processes the quality of water is decreasing continuously and is posing a great threat to all forms of life including humans. Polluted water is the major cause for the spread of many epidemics and some serious diseases like cholera, tuberculosis, typhoid, diarrhea etc. Although several attempts have been made by a number of researchers (Harrison, 1958; Lenat and Crawford, 1994; Biggs, 1995; Gergel *et al.,* 1999; Caraco *et al.,* 2003; Donohue *et al.,* 2006) to study various aspects of water quality and the factors responsible for its degradation in order to formulate a significant control strategy all over the globe yet the problem is on rise. The need of the hour is to take immediate steps to treat the water and minimize its negative impacts. The fast changing lifestyle of Kashmir valley for last few decades including; the increasing rate of construction, development of small scale industrial units, increasing rate of transportation, human population, immense use of fertilizers and pesticides and use of some other harmful substance have bring a drastic change in the quality of water in almost all water bodies of valley including river Jehlum which has posed a great threat to life, therefore it was felt a must to take an initiative in to the same line in order to gain some kind of knowledge about the said problem. Keeping the same in view the present study was taken into consideration in which an attempt was made to access the water quality of River Jehlum and it is believed that this study would be helpful in formulating control strategy in near future.

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II. Materials and Methods

The water samples from five sites of the River Jehlum were collected on monthly basis and were analyzed for detection of concentration of inorganic substances followed by standard methods (Apha, 1975; Golterman and Clyno 1969).Temperature was recorded by using a mercury filled thermometer. The thermometer was shaded from the direct sun light while taking the readings and the results were expressed as °C. pH of the water was determined by electrometric method using a laboratory pH meter, before taking the readings the Ph meter was caloberated by using buffer solution of pH 4 and Ph 9.2. All the readings were taken at 25 °C. Conductivity was determined by electrometric method using a laboratory conductivity meter. The alkanity was examined by using phenolphthalein indicator. Dissolved oxygen was determined by iodometric azide modification method. Chloride was estimated by argentometric titration method in the form of silver chloride,. Nitrate and nitrate was estimated by using colorimeter in the form of diazonium salts which combines water 1-nepthlene hydro chloride o from pinkish redazodye. While free Carbon dioxide was estimated by tetrameter method.

III. Results

The results obtained during the present study show that the physico-chemical nature of water of the river Jehlum has been affected and the concentration of some of the constituents has crossed the permissible

limit as recommended by WHO. At all the study sites minimum air temperature was recorded in the month of January 2009, with the lowest recorded temperature as 2.12 °C at site A, while as the maximum in the month of July 2010, with the highest 35.42 °C at site 3. Overall the temperature was high in summer and low in winter on an average. There was a moderate increase in temperature while moving downstream of the river. The pH was found within the range of 7.74-8.90 with the highest recorded at site A followed by B and C respectively, the pH was decreasing while moving downstream from site A to site C. Like wise the concentration of dissolved oxygen show a continuously decrease from site A to site C, the dissolved oxygen concentration was in between 6.25-7.75mg L^{-1} with the minimum concentration at site C and the maximum at site A. However the situation was reverse in case of free carbon dioxide the concentration of free carbon dioxide was observed in between 0.2-3.12mg/litter and was highest at site C followed by B and A respectively. The concentrations of pH and dissolved oxygen were slightly higher during winter as compare to summer while as the concentration of free carbon dioxide was higher in summer and low in winter. There was a positive correlation in between pH and dissolved oxygen while a negative correlation between pH and dissolved oxygen with free carbon dioxide.

Like wise the conductivity was within the range of 299 μs cm^{-1} at site A in the month of June to 455 μs cm^{-1} at site C in the month of August, while site B recorded a conductivity of 368. The conductivity was found less than the permissible limits.

Chloride in water is generally due to the salts of sodium, potassium and calcium in the present study the chloride content was in the range group of 5.32-15.45mg/litre, being highest at site C (15.45mg/l) in the month of April and lowest (5.32 mg/l) at site A in the month of January, while site B recorded a concentration of 6.53 mg/l. The comparison of chloride content of present values with that of the WHO reveals that it is much lower than the permissible limits.

It was also observed that the concentration of nitrates was more than the permissible limits. The value ranged between 320mg/litter at site B to 630mg/l at site C and it was 485 mg/l at site A. Similarly the concentration of nitrite was within the range of 61-197mg/l with the highest concentration at site C (197.5 mg/l) followed by B (115.3 mg/l) and A (61.56 mg/l) respectively. Furthermore it was also observed that the concentration of calcium was varying with respect to the sampling sites and was within the range of 36.8-57.6mg/l which is within the permissible limits. The average concentration was lowest at site A (37.20 mg/l) followed by B (42.31 mg/l) and C (47.64 mg/l) respectively.

Table 1 : Physico-chemical properties of Water at different sites of River Jehlum

Parameters	Sampling Sites		
	A	B	C
Temperature (°C)	2.12 (Min)	16.13 (Avg)	35.42 (Max)
pH	8.90	7.92	7.74
Conductivity (μs cm^{-1})	299	356	455
Alkanity (mg/l)	100	110	116
Free CO2 (mg/l)	25	28	24
Chloride (mg/l)	11	15	13
Nitrates (μg/l)	926	1370	1308
Nitrites (μg/l)	197	115.3	61
Calcium (mg/l)	42	37	47

IV. Discussion

The results obtained during the study show that the geographical location and season have a direct impact on the various physico-chemical properties of river Jehlum. Air temperature at different study sites followed the general climatic regime of the valley with minimum in January and maximum in July. Although the winter air temperature at times goes below freezing point yet the water did not freeze the reason for which could be the insulating function of snow and ice(Sheridan, 1961), also the temperature required to freeze running water is very low (Needham and Jones, 1959). The reason for comparatively low temperature at site A could be due to the presence of more plants at this site which shades the site at their and makes it less visible to direct sun light. The alkaline nature of water could be attributed to the buffering properties of some inorganic substances (Kang *et al.,* 2001). The increase conductivity towards downstream could be due to the increased urban and agriculture land use drainage into the river (Gray, 2004). The various ions added to the water from catchment areas regulate the conductivity of the water (Golterman, 1975). The higher concentration of DO during winter could be due to the fact that cold water contains more oxygen as compared to warm water as the DO is inversely proportional to the water temperature (Hynes, 1960) in addition photosynthesis could have some kind of effect on DO (Berg, 1943). The increasing trend of free carbon dioxide down the river could be due to the addition of some carbon rich substances as majority of carbon comes from organic matter such as ground water, rock leaching, dead

terrestrial plant material (Wetzel, 1992). The gradual increase in chloride concentration down the river could be due to the increase in urban land use and due to the addition of some industrial/factory discharge (Livingstone, 1963; Woods, 1965; Allan, 1996).The reason for higher concentration of nitrates than the permissible limits could be due to the excessive use of fertilizers, pesticides and addition of human excretory products. The downward increase in nitrite is in contest with many reports allover the world; Osborne and Willey, 1988; Field *et al.,* 1996; Herlihy *et al*., 1998. This could be because of the less concentration of dissolved oxygen in lower parts of river which decreases the conversion of nitrate and nitrite. The reason for increasing trend of calcium down the river could be increased concentration of waste material especially the calcium rich substances like bones and milk products of slaughtered and killed animals.

V. Conclusion

From the present study it is clear that the water quality of River Jehlum has been degraded qualitatively and the concentration of some constituents has passed the permissible limits and this could pose a great threat to the all kinds of life directly or indirectly therefore steps must be taken to protect this divine gift of nature and the present study is a step towards the same.

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Mosquito Repellent Activity of Phytochemical Extracts from Peels of *Citrus Fruit Species*

By Effiom, O. E. Avoaja D. A , & Ohaeri, C. C
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Abstract - The mosquito repellent activity of phytochemical extracts from Peels of five *citrus fruit species*, Citrus sinensis, Citrus limonum,Citrus aurantifolia, Citrus reticulata and Citrus vitis, was investigated. The volatile phytochemical extracts were obtained from processed air-dried and powdered citrus fruit peels by Soxchlet extraction using Diethyl Ether as solvent. Five different concentrations, 5%, 10%, 15%, 20% and 25% (volume by volume) were prepared from each extract stock. Topical application of the extract concentrations on human volunteers revealed that 20% and 25% repelled mosquitoes 2 hours and 5 hours, respectively. Short-lived and mild skin itching and sneezing reactions were observed as side effects. This study has shown that phytochemical extracts from species of citrus fruit have good promise for topical repellence against mosquitoes generally.

Keywords : *Phytochemical extracts, Peels, Citrus fruits, and Mosquitoes..*

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I. Introduction

Malaria is one of the commonest and major parasitic infections of public health interest in the globe especially in the tropics and sub-tropics. It still remains the principal cause of morbidity and mortality in all sub-saharan countries up to this day. Malaria accounts for 10% - 30% of all hospital admissions, and is responsible for 15% - 25% of all deaths in children under the age of 5 years. Pregnant women are not be exonerated from the risk of malaria infections as the disease is also said to be responsible for a substantial number of miscarriages and underweight births (WHO, 1996; RMB, 2007).

Globally, only mosquitoes of the genus Anopheles have been incriminated as the vectors of this life-threatening disease. Therefore the control of malaria invariably implies sustainable control of its vectors. One of the best control measures is the application of intervention methods. Such intervention methods involve the use of insecticides, larvicides, topical repellents, among others, to intercept the vector-host interactions or contact. Cutting off or breaking the link between mosquito vectors and human hosts consequently disrupts the life cycle of malaria parasite. The overall result is the reduction in morbidity and mortality rates following reduced transmission of the disease (Toure, 2002).

Beside from the use of insecticide treated nets (ITNS), many other different types of substances, natural and synthetic, have been discovered and adopted to protect human hosts against mosquito bites. These substances keep mosquitoes from biting humans and make human hosts undetectable, or are anti-mosquito cloak that conceal or hide the host from recognition by mosquitoes, as a meal source (Jacobson, 1990; Foster and Duke, 1990; ICMR, 2003). Today citrus essential oils as well as extracts from other plants such as Cedar wood, *Citronella, Eucalyptus, Pennyxoyai*, Turpentine, Winter green (Sadik, 1973), have been identified as very important natural resource of either pesticides or insecticides (Raguraman and Singh, 1997; Gbolade, 2001), or repellent (Sadik, 1973; Thorsell *et al*., 1998; Oyedele *et al*., 2000; Govere *et al*., 2000; Girgenti and Suss, 2003). They have been used as both topical preparations and combustible products like incense sticks to repel insects such as mosquitoes. In some places, dried citrus fruit peels are burnt on charcoal fire to repel and/or destroy mosquitoes in homes.

The global preference of phytochemicals in malaria vector control may be based on their unique properties which include environmental sustainability, easily biodegradable, readily available and cheap and non-toxicity to man and his domestic animals (Herrera and Vieto, 1980; Duke, 1992).

Repellent and attractant properties of phytochemicals from plants other than citrus plant species have been investigated by various scholars (Tyagi *et al*., 1994; Ansari and Razdam, 1995; Trigg, 1996; Pathak *et al*., 2000; Moore *et al*., 2002).

This study aimed at investigating the repellent activity of phytochemical extracts from peels of five *citrus fruit species, Citrus sinensis* (sweet orange), *Citrus limonum* (lemon), *Citrus aurantifolia* (common lime), *Citrus reticulata* (tangerine) and *Citrus vitis* (grapefruits), with a view to finding the most effective extact that can be recommended and adopted as mosquito repellent.

II. Materials and Methods

a) Sources of citrus fruits

The five species of citrus- *Citrus sinensis, Citrus limonum, Citrus aurantifolia, Citrus reticulata, Citrus vitis*,

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were obtained from open market (Ika-Ika Qua and Watt market) in Calabar. They were washed with clean water and dried with clean towel.

b) Preparation of extracts

The peels were obtained from the fruits, spread on clean white cardboard papers and air-dried on the laboratory benches for 3 weeks. The dried peels were ground into powdered materials using a manual grinding machine (Corona model) and stored in air-tight 250ml transparent plastic containers. Enough quantities (400g) of the powdered materials were prepared to be able to yield up to 500ml of extract from each citrus species. Phytochemical extraction from the powdered materials was done using Soxchlet extractor with Diethyl Ether as solvent in the Analytical Laboratory of the Department of Pure and Applied Chemistry, University of Calabar, Calabar. 100g of the powder was fed into the Soxchlet apparatus (2L) and 500ml of Diethyl Ether was added and mixed. The mixture was heated until citeus volatile oil or phytochemical was exhaustively extracted at a temperature range between 60°C and 80°C for 6hours. The extract was then left overnight at the laboratory temperature (28°- 30°C) for the remaining ether in it to evaporate.

c) Recruitment of human volunteers

The 165 human volunteers used in this study were recruited from three different areas of Mbukpa in Calabar (Cross River South, Ekori in Yakurr (Cross River Central) and Mbube in Ogoja (Cross River North) of Nigeria. That is, 55 volunteers in each area. But first, ethical permission was sought and obtained from the Cross River State Ministry of Health, Calabar, through an application which carried a written detailed proposal of the study to undertaken. This ethical permission, signed by the Commissioner for Health himself, together with the thought-provoking lecture by the team on the menace of malaria and the need to control it, helped to win the interest and co-operation of the chiefs, leaders of thought and the entire people of the study areas. Furthermore, the study, its importance in malaria control and the sources of the phytochemical extracts to be tested were explained in both English and their respective local dialects. The people were then allowed to declare individually, their consent and willingness to participate as volunteers. Although many people indicated interest only 55 persons (adult males and females only) were chosen randomly in each area to participate. Again, these chosen volunteers were still given the opportunity to opt out any time they wished do so.

Five different grades or concentrations were prepared volume by volume (5%, 10%, 15%, 20% and 25%) from each extract stock. They were then applied topically on the skin of uncovered portions of the body (i.e. hand, legs and face) of the first set of 50 human volunteers (i.e. 2 persons per concentration), in Mbukpa, 'Calabar' area. These people were exposed several hours (from 6pm to 6am) for mosquito bites in the area that was sufficiently exposed and heavily infested with mosquitoes. The other 5 volunteers were left without topical application of the extracts to serve as control experiment. Bright torchlights were used to view the volunteers' reaction to bites. The observations were recorded at 30 minutes intervals to know when mosquito bite began. The exercise was repeated with the other two sets of 55 human volunteers each on different days in Ekori (Yakurr) and Mbube (Ogoja), respectively.

III. Results

The results obtained in these demonstrations were as shown in below Appendix.

The results showed that 5% concentration of all the extracts did not exhibit any repellent effect. The 15% concentration of the extract peels of all citrus species repelled mosquitoes for a very short time (< 1 hour), after which biting commenced. 20% concentration of all the extracts produced moderate repellent effect of more than 2 hours (> 2 hours). Similarly, extracts from all citrus species except *C. vitis* showed long-lasting repellent effect of more than 5 hours (> 5 hours). Only the volunteers used as control experienced frequent and uncontrolled mosquito bites from the beginning of the demonstration to the end.

However, a few volunteers reported mild and short-lived skin itching and sneezing reactions arising from extracts from peels of *C. sinensis, C. limonum, C. reticulata and C. aurantifolia* compared to individuals without topical application used as control in the three demonstration areas.

IV. Discussion

Demonstration of repellent activity of the volatile phytochemical extracts by topical application on some bare portions of the body (hands, legs and face) of the human volunteers produced encouraging results. All the extracts from the different species of citrus fruits exhibited repellent activity in their different concentrations though with varying degrees of time duration with the exception of 5% and 10% concentrations that did not produce any repellent effect. In extracts where 15% concentration recorded repellent effect, it was of very short duration (< 1 hour). The repellent effects of the citrus phytochemical extracts were more pronounced in higher concentrations (of 20% and 25%).

The observed variability of repellent activity amongst extracts from the different *citrus fruit species* may suggest that repellent activity is not only dependent on the concentration of a phytochemical extract but also on the source (i.e., the *citrus fruit species*) from which it was obtained. The mode of action of these phytochemicals can not be unconnected with the suggestions made earlier by Jacobson (1990) and Foster and Duke (1990) in their separate studies on terpene-like nepetalactone of catnip plant, and Govere

et al., (2000), Girgenti and Suss (2002), in their respective studies on repellent activity of natural vegetable extracts against *Aedes aegypti*. The mosquitoes do not understand anything disgusting in the extracts from citrus peels to repel them. They were merely not attracted as they could normally be under normal circumstances. Perhaps the active ingredients (alkaloids, flavonoids, saponins, phenolics and tannins), present in the phytochemical extracts from the citrus peels might have exerted some inhibitory effect on lactic acid receptor cells by masking or changing the lactic acids that normally attract them thereby confusing or distracting the mosquitoes (Ansari and Razdam, 1995). Thus, the blood-feeding contact or response is prevented. Consequently, with the application of the phytochemical extract on the skin, the mosquito could not bite because the active ingredients does not allow it to smell the attractant (lactic acids) and could not therefore identify the human as its source of meal. This suggests that the active ingredients confused the olfactory receptors and the mosquito simply could not smell the host. It is suspected that the active ingredients in the citrus volatile phytochemical extracts when worn on the bare skin evaporate and are released with CO_2 from the host, thereby changing the human CO_2 signature to that of plants. By this the visiting mosquito now perceives plants' CO_2 and not that of human that it is looking for (Jacobson, 1990; Foster and Duke, 1990).

The skin itching and the sneezing reactions experienced by the human volunteers can be regarded as mere individual allergy especially as the reactions were mild and short-lived.

V. Conclusion

Phytochemical extracts from citrus fruit peels have proved effective as mosquito repellents at reasonable concentrations.

VI. Acknowledgement

The team is grateful to all the people that had contributed to the success of this study. Prominent among them are the Honourable Commissioner for Health, Cross River State, Dr Edet Ikpi, for granting us ethical permission, the Chiefs and Leaders of thought of the three demonstration areas of Mbukpa, Ekori and Mbube, for their wonderful understanding and co-operation. Most importantly are all those who willingly offered themselves to be used as human volunteers in this study. Also worthy of acknowledgement are the immeasurable contributions of the Head of Department of Pure and Applied Chemistry, University of Calabar, Calabar, and Mr. Emmanuel Okon Effiom (the Assistant Chief Technologist) incharge of the Departmental Analytical Laboratory, for helping to extact the volatile phytochemicals from the citrus fruits.

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Appendix

Table 1 : Repellent activity of volatile phytochemical extracts of citrus fruits using human volunteers at Mbukpa (Calabar) area of Cross River State

Sources of extract (peels)	Activity of the different concentrations				
	5%	10%	15%	20%	25%
Citrus sinensis (Sweet orange)	No effect	No effect	Short-lived effect (<1 hr)	Moderate effect (> 2 hrs)	Long-lasting effect (> 5 hrs)
Citrus aurantifolia (Lime)	No effect	No effect	Short-lived effect (<1 hr)	Moderate effect (> 2 hrs)	Long-lasting effect (> 5 hrs)
Citrus limonum (Lemon)	No effect	No effect	Short-lived effect (<1 hr)	Moderate effect (> 2 hrs)	Long-lasting effect (> 5 hrs)
Citrus reticulata (Tangerine)	No effect	No effect	Short-lived effect (<1 hr)	Moderate effect (> 2 hrs)	Long-lasting effect (> 5 hrs)
Citrus vitis (Grapefruit)	No effect	No effect	Short-lived effect (<1 hr)	Moderate effect (> 2 hrs)	Long-lasting effect (> 5 hrs)

Note : < = less than; > = more than; no effect = no repellent effect.

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Estimation of Tropospheric Refractivity with Artificial Neural Network at Minna, Nigeria

By Ibeh G.F & Agbo G.A
Ebonyi State University, Abakaliki

Abstract - The study of refractivity and its effect at the tropospheric region is very important as the parameters help in planning for communication links. This study is aimed at calculating and estimation of refractivity at the tropospheric region with tropospheric parameters of relative humidity, absolute temperature and atmospheric pressure of January and October at Minna, Nigeria. The ITU-R, model and artificial neural network model were used. Validation results are thus, January, absolute temperature = 0.4313 K, relative humidity = 0.9989 %, pressure = 0.0201 (hpa) and October, absolute temperature = -0.3146 K, relative humidity = 0.9597 % and pressure = 0.1962 respectively. The validation of the correlation coefficient results show that all the tropospheric parameters has effects on refractivity, but relative humidity has more effect and is merely on October which was attributed to the large quantity of moisture at the tropospheric region during the rainy season which is between April to October as stated by Adadiji. From Table 1 and 2 and figure 1 to 6, it clear that ANN has the capacity of estimating refractivity since the estimated values has close agreement with the calculated values.

Keywords : *Troposphere, refractivity, artificial neural network, atmosphere.*

GJSFR-E Classification : *FOR Code: 020599*

Strictly as per the compliance and regulations of :

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I. Introduction

The structure of the radio refractive index, *n*, at the lower part of the atmosphere is a very important parameter in planning of the communication links. The atmosphere which is the propagation medium for radio transmission is characterized by different refractive indices at different levels (Oyedum and Gambo 1994). These varying indices significantly affect radio wave propagation.

Multipath effects arise due to large scale variations in atmospheric radio refractive index, such as horizontal layers with very different refractivity (Grabner, and Kvicera, 2003). This effect becomes noticeable, when the same signal takes different paths to its target and the rays arriving at different times thereby interfering with each other during propagation through the troposphere. The consequence of this large scale variation in the tropoospheric refractive index is that radio waves propagating through the atmosphere become progressively curved towards the earth. Thus, the range of the radio waves is determined by the height dependence of the refractivity. Therefore, the refractivity of the atmosphere will not only affect the curvature of the ray path but will also provide some insight into the fading of radio waves through the troposphere. These have led to the interest of looking at the possibilities of using a model to estimate refractivity with tropospheric parameters. Artificial neural network (ANN) model is a computer software program that behaves the same way as the human brain. The network usually consists of an input layer, some hidden layers and an output layer.

This work aims at using artificial neural network (ANN) model with meteorological parameters of absolute temperature, pressure, and relative humidity as input data to predict refractivity at Minna, Nigeria.

II. Materials and Procedures

a) Source of Data

The meteorological data of relative humidity, temperature and pressure were obtained from the Centre for Basic Space Science (CBSS), University of Nigeria Nsukka. Equations (2) and (3) given below were used to compute the values for refractivity and water vapour pressure (*e*). The geographical location of the area Minna is as shown in table 1.

Table 1 : Geographical location of the station

Station	latitude	longitude	Attitude (m)
Minna	9.37^0 N	6.30^0 E	256

b) Theory of Refractivity

Radio –wave is determined by changes in the refractive index of air in the troposphere. Because it is close to unity (about 1.0003), the refractive index of air is measured by a quantity called the radio refractivity, N which is related to refractive index, n as (ITU-R, 2003):

$$N = 1+N \times 10^6 \quad (1)$$

In terms of measured meteorological quantities, the refractivity N can be expressed as:

$$N = 77.6\frac{p}{T} + 3.73 \times 10^5\left(\frac{e}{T^2}\right) \quad (2)$$

Where : p = atmospheric pressure (hpa), e = water vapour pressure and T = absolute temperature (K).

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The water vapour pressure e is usually calculated from the relative humidity with the following equation:

$$e = \frac{RH}{100} \text{a exp } \left(\frac{b\ t}{t + c} \right) \quad (3)$$

Where the temperature is given in ℃ and the coefficients a, b and c take the following values: a = 6.1121, b = 17.502, and c = 240.97.

Therefore,

$$e = \frac{RH}{100} 6.1121 \text{ exp } \left(\frac{17.502\ t}{t + 240.97} \right)$$

Where : RH = relative humidity (%), t = temperature in degree Celsius ℃.

c) Procedure of Artificial Neural Network Estimation

For the estimation of tropospheric refractivity, 3-2-1 multilayer peceptron (MLP) neural networks were used, which includes the input layer, a linear output layer and a sigmoid hidden function. In order to predict the tropospheric refractivity, a classifier were developed, which merely associates the ground values of pressure, absolute temperature and relative humidity and predicts the tropospheric refractivity at Minna for the specific observatory period. The selection of sigmoid transfer function is because it allows any relation between the system predictors and the output.

The network predictors consist of 3 X N matrix, where each row represent the ground pressure, absolute temperature and relative humidity respectively for total of N observatory period, while each colum stands for the days used, which can be derived from equation (4). In order to validate the refractivity results and investigate for any further improvement and recommendation of the model, regression analyses were carried out.

d) Theory of Artificial Neural Network Model

The neurons act like parallel processing units. An artificial neuron is a unit that performs a simple mathematical operation on its inputs and imitates the functions of biological neurons and their unique process of learning (Ibeh et al, 2012). From Fig. 1 we have that weighed sum of the inputs

$$\boldsymbol{v_k} = \sum_{j=1}^{N} \text{x}_\text{j}\ w_{kj}\ + b_k \quad (4)$$

is calculated at kth hidden node.

w_{kj} is the weight on connection from the jth to the kth node; x_j is an input data from input node; N is the total number of input (N = 31); and b_k denotes a bias on the kth hidden node. Each hidden node then uses a sigmoid transfer function to generate an output

$$\text{z}_k = [1+e^{(-v_k)}]^{-1} = f(v_k) \quad (5)$$

between -1 and 1.

We then set the output from each of the hidden nodes, along with the bias b_0 on the output node, to the output node and again calculate a weighted sum,

$$y_k = \sum_{k=1}^{N} \text{v}_\text{k}\ z_k\ + b_k \quad (6)$$

Where N is the total number of hidden nodes; and v_k is the weight from the kth hidden node to the sigmoid transfer function of the output node.

III. Results and Discussion

Table 2 is the estimation of refractivity of meteorological data of absolute temperature, relative humidity, atmospheric pressure, calculated refractivity and artificial neural network estimation of refractivity at Minna of January and October, 2009 respectively. Figure 1 is the network diagram. Result obtained for the daily calculated and estimation of tropospheric refractivity at Minna for January and October is presented in Table 2 respectively.

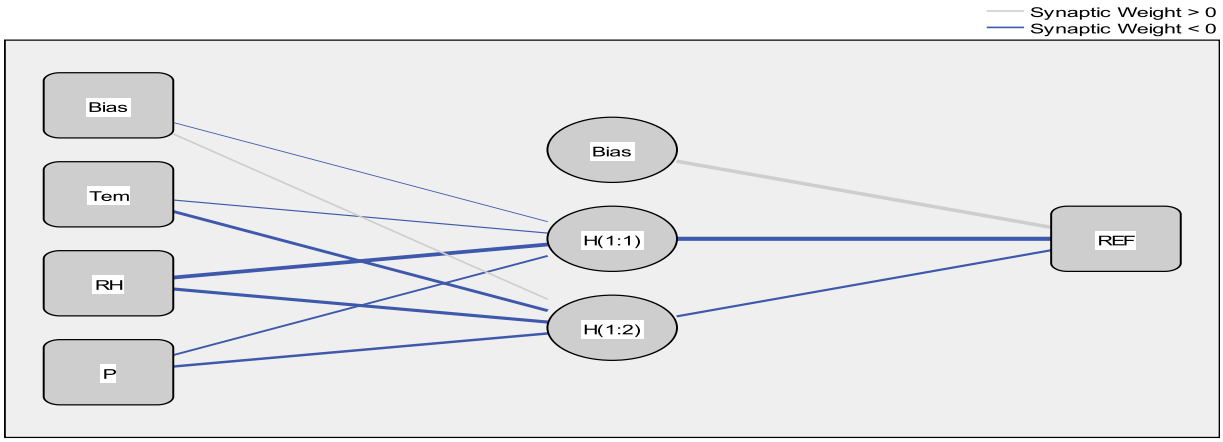

Figure 1: Network Diagram

In Table 2 a large difference between the values of refractivity in January and October is highly observed. The refractivity value is higher in October. This could be attributed to high values of relative humidity.

The high refractivity value confirmed the statement of Adadiji, (2008) that refractivity values are observed to be generally high during the rainy season (April – October). He further stated in his work that the high values are due to high air humidity (very close to 100%).

The validation analysis of correlation coefficient on the effect of tropospheric parameters on refractivity show that relative humidity has close to 100% effect.

The correlations analysis of refractivity with all the atmospheric parameters shows that the correlation coefficient of refractivity with each of temperature, relative humidity and pressure at Minna for January are o.43, 1.0 and 0.02 respectively. In October the correlation coefficients are respectively -0.31, 0.96 and 0.20. From the result in January, refractivity is completely influenced by relative humidity. In October, the influence is a little bit less than that in January. The overall result indicates that relative humidity has greater influence on refractivity with the two different months or season considered. Temperature and pressure has little or no effect on refractivity under the period of study hence their low correlation coefficient with refractivity.

From Table 2 and figure 2 to 7, it is clear that ANN can be use to estimate tropospheric refractivity of Minna, since both the calculated and estimated values has close agreement.

From table 2 to 7, ANNref represent refractivity estimation of artificial neural network, Tem. represent absolute temperature, RH represent relative humidity, Ref represent refractivity respectively.

IV. Conclusion

The study of refractivity and its effect at the tropopsheric region of Minna in Nigeria is a very important as the parameters help in planning the communication links. The validation of the correlation coefficient results show that all the tropospheric parameters have effects on refractivity, but relative humidity has more effect and is merely on October which was attributed to the large quantity of moisture at the troposphere during the rainy season which is between April to October as state by Adadiji. From Table 2 and figure 2 to 7, it is clear that ANN has the capacity of estimating refractivity.

Acknowledgement

Authors wish to express their profound gratitude to the management and staff of the Centre for Basic Space Science (CBSS), University of Nigeria, Nsukka for supplying the data for the tropospheric parameters of this work.

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Table 2 : Minna Meteorological Data For January October, 2009

	Atmospheric parameters estimation in January		Atmospheric parameters estimation in October	
Date	Refractivity, N-units	ANN_{REF} N-units	Refractivity, N-units	ANN_{REF} N-units
1/1/2009	271.0544525	274.60	356.5481052	357.08
2/1/2009	275.3722889	274.90	355.9020258	356.21
3/1/2009	275.3163324	274.99	349.5771302	349.66
4/1/2009	279.6008402	276.31	346.5879717	346.35
5/1/2009	274.8514794	275.76	345.5941351	345.41
6/1/2009	273.0597755	274.86	343.1590852	343.35
7/1/2009	292.986399	290.92	361.7624981	359.94
8/1/2009	268.3168988	274.19	357.799226	358.17
9/1/2009	338.6648802	328.01	357.4811448	357.48
10/1/2009	322.5500852	325.63	353.762127	354.26
11/1/2009	328.5559534	327.62	347.6803539	347.69
12/1/2009	333.8285224	328.01	355.1351964	355.40
13/1/2009	270.2412859	272.80	352.5858326	352.50
14/1/2009	273.1603293	274.14	344.4727377	344.55
15/1/2009	278.9883037	278.07	357.6435149	357.72
16/1/2009	307.3309620	315.62	355.2199322	356.02
17/1/2009	316.8938847	324.33	351.2342304	351.28
18/1/2009	328.7936466	327.59	354.5881569	354.40
19/1/2009	312.2606525	325.48	353.7259292	353.54
20/1/2009	283.8785572	274.93	349.906618	349.72
21/1/2009	275.6875823	273.40	349.6676148	350.00
22/1/2009	270.6980512	274.48	351.1906812	350.66
23/1/2009	272.9680961	275.28	344.2962555	343.84
24/1/2009	275.3075448	275.98	348.6706128	348.50
25/1/2009	277.3180941	274.51	349.0745612	348.93
26/1/2009	295.2679312	292.11	344.3451933	344.78
27/1/2009	291.2213452	289.20	341.6831885	342.37
28/1/2009	283.4740147	280.91	347.5362109	346.96
29/1/2009	332.5238012	327.59	349.6991945	349.24
30/1/2009	278.7621149	277.08	352.0536456	351.30
31/1/2009	314.2687866	323.95	337.1522459	340.67

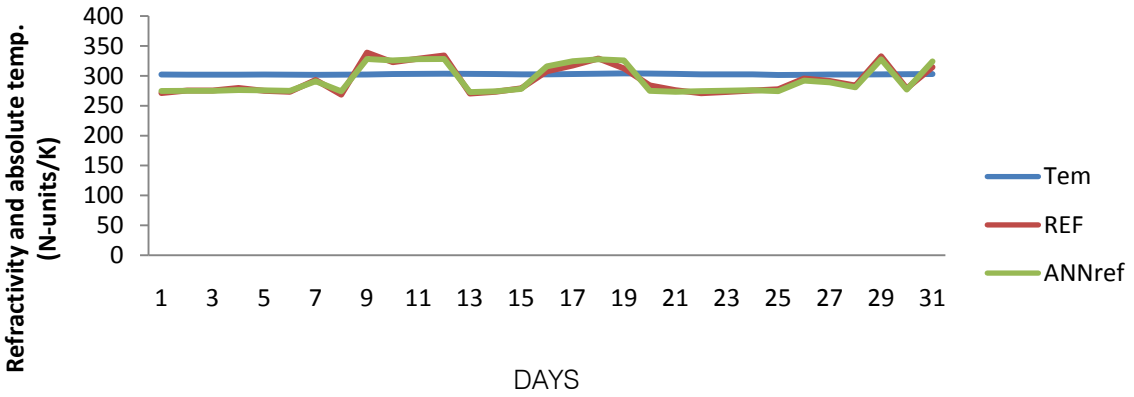

Figure 2: Graph of absolute temperature, refractivity and ANN refractivity Estimation for January at Minna

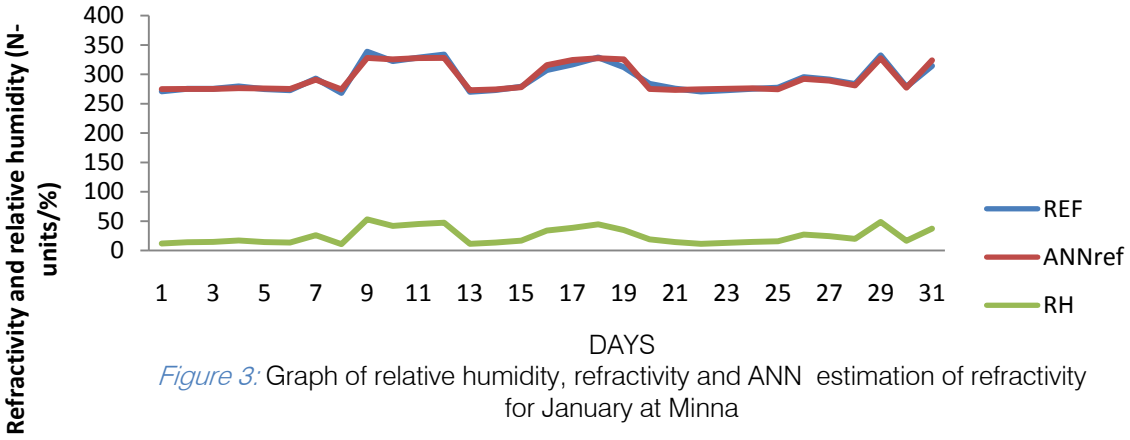

Figure 3: Graph of relative humidity, refractivity and ANN estimation of refractivity for January at Minna

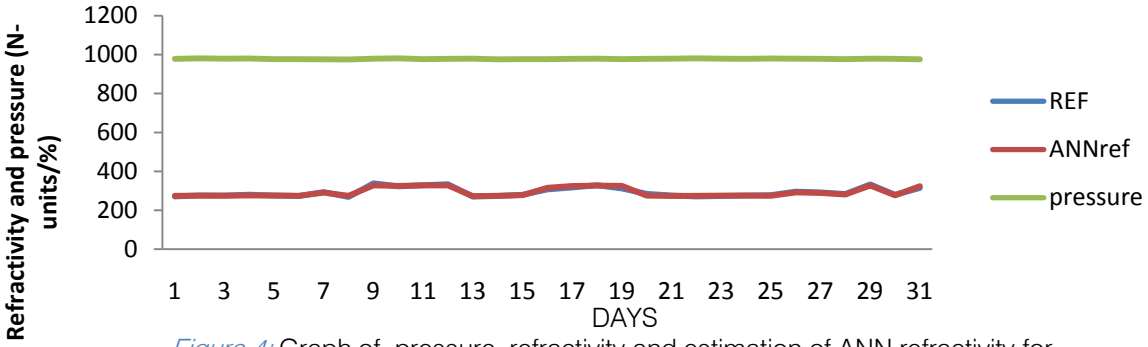

Figure 4: Graph of pressure, refractivity and estimation of ANN refractivity for January at Minna

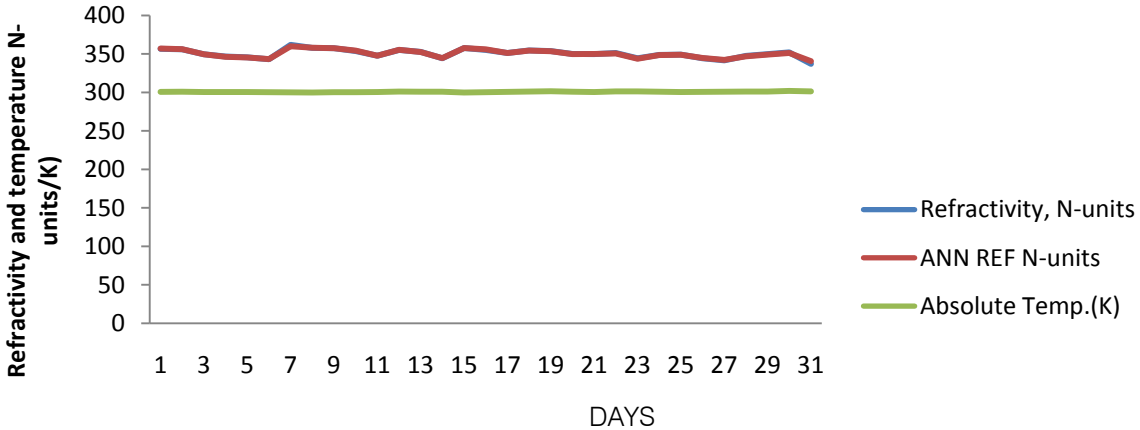

Figure 5: Graph of absolute temperature, refractivity and estimation of refractivity of October at Minna

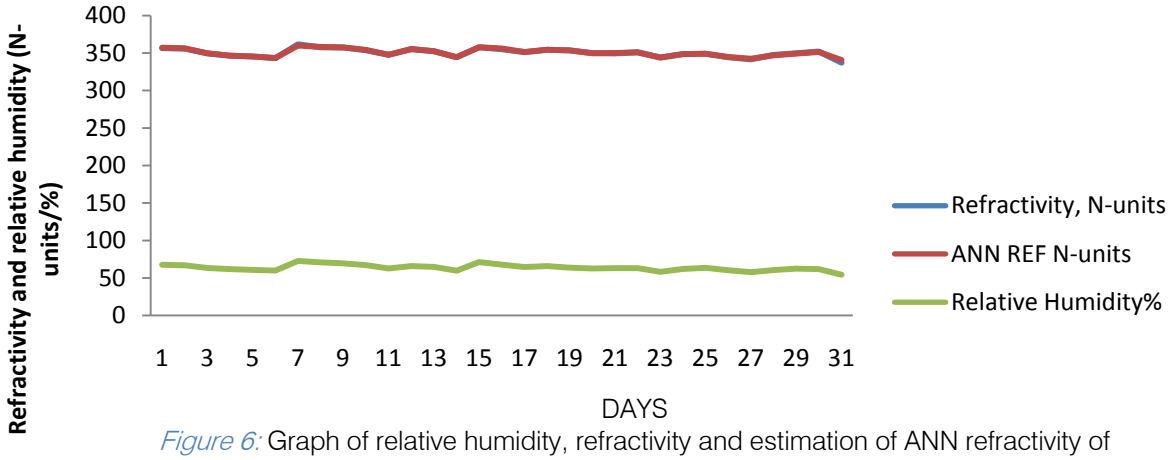

Figure 6: Graph of relative humidity, refractivity and estimation of ANN refractivity of October at Minna

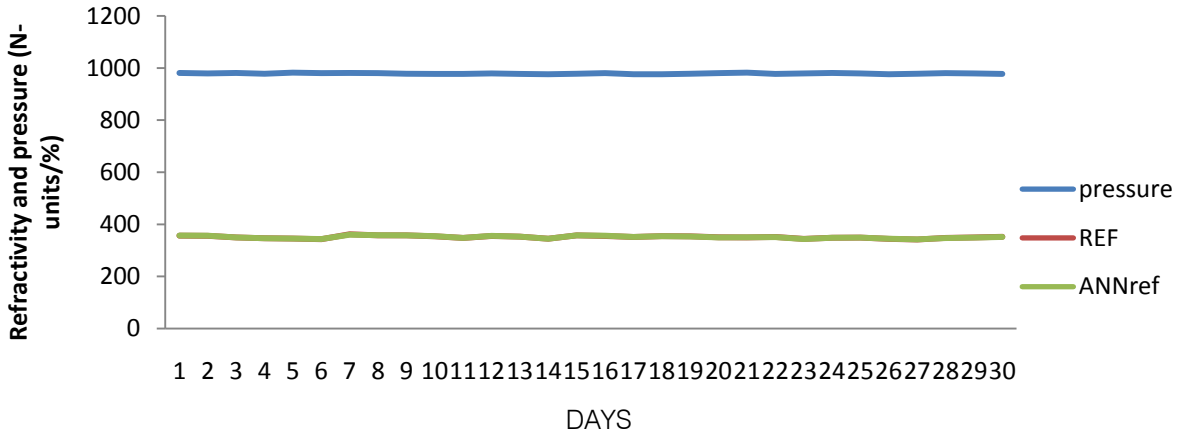

Figure 7: Graph of pressure, refractivity and estimation of ANN refractivity of October at Minna

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India's Readiness on ROHS Directives: A Strategic Analysis

By Dr. Sandip Chatterjee
Ministry of Communications and Information Technology Electronics Niketan , India

Abstract - The materials are essential for critical performance of electronic products. Disposal of some of these materials, however, poses a serious threat to the environment after endof- life of the product. The European Union and other developed countries have already enacted legislative measures as Restriction of Hazardous Substances (RoHS) Directive to restrict the use of certain substances in the manufacturing of the electronic products. India has also notified similar legislation on 12th May 2011 to address this serious issue. Indian electronic manufactures are however facing serious challenges due to this legislative restriction. Industry needs testing and certification of admissible level of hazardous substances in the product for necessary compliance. The testing facilities available with few private laboratories are not adequate. Department of lectronics and Information Technology, Government of India, has therefore created a state-of-art laboratory with modern analytical instruments to address the growing demand of the industry. This article provides an overview of the RoHS and other related legislative measures present in the world and in India. An attempt is also made to study the preparedness of the industry and the immediate impact on the business of electronic sector.

Keywords : *Electronic waste, end-of-life electronics,RoHS, environmental electronics.*

GJCST Classification: *K.4.4*

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Keywords : Electronic waste, end-of-life electronics, RoHS, environmental electronics.

I. Introduction

Electronic materials are at the core of design and development of components and modules, which are in turn the heart of electronic products. The performance of the electronic products solely depends on the critical properties of the materials present in the products. Modern electronics is driven by innovations in advanced materials. Some of these materials are, however, not environmentally-friendly. The demand for electronics products has been enhanced manifold with massive growth of the electronics and hardware sector. Fast change of features in electronics devices and availability of improved products forces the consumers to dispose of the electronics products rapidly. This has alarmingly increased the generation of electronic waste. European Union (EU) had realized that all hazardous substances from the electronic and electrical equipments cannot be recycled or disposed of in an environmentally sound and safe manner.

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The EU had first enacted Restriction on Hazardous Substances (RoHS) directive on August 13, 2004 to control the hazardous substances in electrical and electronic products (*source:http://ec.europa.eu/environment/waste/weee/lgis_en.htm*). Several countries have now introduced similar rules to address the issue. Ministry of Environment and Forests (MoEF), Government of India has also notified first ever exclusive rules as electronic waste (Management and Handling) Rules, 2010 on 12th May 2011 (*source: http://moef.nic.in/downloads/rules-and-regulations/1035e_eng.pdf*). The rule includes restrictions on and reduction of the use of hazardous substances in the manufacture of the electrical and electronic equipments.

The present electronic waste rule will have a significant impact on the business of electronics products in India and the world electronics industry. India is a growing consumer market. Every electronics manufacturing, assembling and trading unit needs to abide by the rules and, therefore, needs to procure and sell components, modules, and products that strictly follow the present rules of the MoEF. In order to honour the present rules, manufacturers need to make products so that materials used in them specifically to comply with the list of prohibited substances. These changes in manufacturing and assembly process would not only affect the electronics industry, but also other industry like electrical, power, telecommunication, automotive etc., where electronic products are used.

The testing of the components and modules used in the electronics products and hardware equipments for RoHS are the initial step towards the compliance of the rules. The compliance would be mandatory for the manufacturing and assembly units. Earlier RoHS compliance was needed for Indian exporters of electronic products to the EU and few other developing countries. In the present scenario, Indian industry would desperately need testing and certification facilities for the RoHS even for domestic market. A few private laboratories have already been established in India to provide such services for the industries. These facilities would be inadequate to meet the growing need for the Indian companies. Department of Electronics and Information Technology has therefore created the, first-ever government-owned National Accreditation Board for Testing and Calibration Laboratories accredited and certification facility at Centre for Materials for Electronics Technology (C-MET), Hyderabad.This article

discusses the immediate impact of the RoHS clause in the present electronic waste rule on the Indian electronics industry and necessary readiness required for coping up the immediate challenges. An attempt has also been made to describe the testing facilities available in India. The article also discusses the function of the equipment, the test procedure and indicative charges of the equipments available in CMET, Hyderabad.

II. What is ROHS?

The Restriction of Hazardous Substances Directive (RoHS) is a Directive of the European Union on the restriction of the use of certain hazardous substances in electrical and electronic equipment. RoHS is one of a handful of European legislation that intended to eliminate or reduce the use of cadmium, hexavalent chromium, and lead in all products from automobiles to consumer electronics. The directive restricted the use of six hazardous materials including Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBB), and Polybrominated diphenyl ether (PBDE) in the manufacture of various types of electronic and electrical equipment with following permissible limits:

- Lead -1000 PPM
- Cadmium -100 PPM
- Mercury -1000 PPM
- Hexavalent Chromium -1000 PPM
- Poly Brominated Biphenyles -1000 PPM
- Poly Brominated Diphenyles Ether -1000 PPM

a) RoHS in Electrical and Electronics Products

The six banned substances are very critical for design and development and functionality of various electronic products (*Sarah et.al, 2008*). Following are some of the applications:

i. *Lead*

Lead is used in following cases:

- Lead acid batteries contain nearly 58% of lead
- Tin-lead alloys are most widely used as solder in electronics industry. The solder is used in personal computers (PC) and laptop, printer and copier, mobile phone, video games, television sets etc.
- Leaded glass and ceramics use lead oxide as an additive. Crystal glass contains 24-36% of lead oxide to shield radiation, which is used in cathode ray tubes in television sets, fluorescent tubes and electrical glass.
- Another important application of lead compounds is as PVC stabilizers as lead salts are most cost effective stabilizers for PVC, which is commonly used in electrical cable insulation, refrigerator racks, cell phone housing, keyboards and computer, monitor housing, cable sheathing in external or internal electric cables.
- Lead is used occasionally as raw material for the synthesis, in electrolysis and in stabilizers

ii. *Cadmium*

Cadmium or cadmium oxides are used in following cases:

- Cadmium oxide is used in nickel-cadmium batteries, where nearly 72% of cadmium is present. Nickel-cadmium batteries are used in cell phones, toys, clocks, older laptops etc.
- Cadmium oxide or metal is used in PVC to retard degradation on exposure to heat and UV light.
- Cadmium is used for metal plating for protection of iron against corrosion.
- Cadmium is a common metal of various alloys used due to their melting temperatures. Tin-lead-bismuth-cadmium alloy joins heat sensitive metal parts, silver-cadmium-copper-zinc-nickel joins tungsten carbide to steel tools.
- Cadmium is also present in copper-cadmium alloys, solders, solar cells (CdTe and CdS) etc. Cadmium plating or solder is very common in semiconductors in computers, toys, mobile phones.

iii. *Mercury*

Mercury is used in following cases:

- Mercury bottom cells are used in watches and batteries
- Mercury is also used in measuring and control instruments, lighting, fluorescent tubes, older switches in some electrical equipment
- Gold and silver recovery in printed circuit board (PCB) recycling plants

iv. *Chromium VI*

Cr (VI) or chromium VI is used in following cases:

- Chromate coatings are used on various metals to protect metal parts from corrosion.
- Chromium in glass is used to achieve emerald green coloured glass
- Chromium VI pigments are important for coating on electrical contacts and fasteners (screws, nuts, bolts, etc.) in aluminium, in all electrical equipment. The chromium coating is also used in cooling systems of refrigerators.
- Chromium coating on copper foil is needed in lithium ion batteries in laptops, mobile phones and video games etc. This coated copper foil is also used on printed circuit boards of all electronic equipment.

v. *Polybrominated biphenyls (PBB) and polybrominateddiphenyl ethers (PBDEs)*

PBB and PBDE are used in different plastics and textiles, as a flame retardant. The brominated flame-retardants are essential in the following products:

- Deca-BDE housings are used in TV sets, mobile phones, wire and cable, connectors in electrical and electronic equipment

- Octa-BDE housings are in TV sets, PC monitors, mobile phones, in connectors, switches, circuit breakers in most electrical equipment, some types of circuit boards, plastic parts in copiers and lamp socket

III. Global Status of Rohs Legislations

The European Union had first initiated the campaign against the Restriction on Hazardous Substances (RoHS) by enacting its Directive 2002/95/EC, the Restriction of Hazardous Substances (RoHS) Directive-2003, effected from August 13, 2004. This directive controls the manufacturing of electronic and electrical equipments using hazardous substances like lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyles, and polybromonated diphenyl ethers exceeding a certain level. The ROHS directive is also known as "Lead-Free" legislation. This directive had, however, exempted certain items such compact fluorescent lamp (CFLs), cathode ray tube (CRT) etc. for which no suitable alternatives are known or limited due to lack of technology.

RoHS compliant electronics products had started entering the EU market since July 1, 2006. The EU countries took pro-active role in banning a number of products containing RoHS using "precautionary and substitution" principles. The RoHS Directive established a regulatory process of placing bans on lead and cadmium, which are essential to the functionality, safety, and reliability of electrical and electronic products. Review of the effects of the directive is being taken time to time at EU. The EU has agreed that bans must be made based on risk assessments. The EU is working to decide whether there should be additional exemptions listed in the RoHS directive. European Commission (EC) reviewed the terms of the Directive in 2008/2009 based on the experiences during the first few years of operations of the RoHS.

The RoHS Directive of the EU was a front running environmental legislation that triggered several similar initiatives around the world. Major initiatives on RoHS were taken in California, Norway, China, South Korea and Japan. Many countries including Australia, New Zealand, Thailand, Malaysia, Taiwan, Canada and Brazil are also seriously considering the matter. New Zealand describes that the countries that did not implement RoHS run the risk of becoming a dumping ground for non-RoHS compliant products. As more and more countries adopt RoHS, the environmental protection campaign strengthens.

a. USA

California's Electronic Waste Recycling Act law prohibits the sale of electronic devices and imposes an advance recovery fee on the sale of electronic products like television, monitors (4'' or greater), cathode ray tubes displays, and laptops from 1st January 2007. The law ensured the disclosure requirement of the restricted material. The law had, however, narrower scope as it included only cathode ray tubes and liquid crystal displays containing four heavy metals restricted by RoHS. This was extended to all the electronic products since 2010. Fees are collected by retailers, managed by the state, and used to fund the recycling programme. Other US states are also discussing the matter seriously to adopt similar law.

a) Canada

Alberta launched Canada´s first provincial electronics recycling program, where an advanced recycling fee of up to US $45 is charged for all the electronics sold in the province since October 2004.

b) New Zealand

The Government of New Zealand outlined, "Product stewardship and water efficiency labeling", from July 2005 to encourage businesses and consumers accept responsibility for the environmental effects of products.

c) Japan

Japan has no direct legislation on RoHS. Recycling laws, however, ensure that the manufacturers move to a lead-free process as per RoHS guidelines. Japanese industrial standard for the Marking of Specific Chemical Substances ensures that electronic products exceeding a specified amount of the identified toxic substances must carry a warning label since 1st July 2006. Advances of eco-design, e.g. 'design for disassembly' and use of 'automated disassembly using smart materials' are evident in Japan. Incentives were provided for design changes and manufacturing of electronics and electrical equipments linked to recycling installations. (Bio Intelligence Service, 2006)

d) South Korea

South Korea issued legislation similar to RoHS known as "The Act for Resource Recycling of Electrical/Electronic Products and Automobiles" on 2nd April 2007 to ban the same hazardous substances as the EU RoHS and also includes the same exceptions. The law was based on self-declaration system, with no special mark needed and does not apply to parts manufactured before 2008 and samples used in Research & Development.

e) China

In China RoHS has been applied to the list of products, which is a subset of the total scope of Electronic Information Products (EIP) from 12th December 2007. Directives point to phase out of heavy metals such as cadmium, mercury, lead, and hexavalent chromium as well as brominated flame retardants in future electronic products. Phase 1 was based on extensive labelling and reporting. The Phase 2 ensured the removal of banned substances.

f) Norway

"Prohibition on Certain Hazardous Substances in Consumer Products" was being considered since 2007. The scope of the law was broader and more stringent for maximum concentration and included more elements. This law extended beyond the electrical and electronics equipments.

IV. Impact of RoHS Legislations on Electronic Products

The electronics and electrical manufactures are becoming more environmentally conscious after implementation of the RoHS directive in the EU. The effect of the directive has already become visible. Electronic products entering in EU market have reduced hazardous substances. A study in the EU has shown a sharp reduction of certain hazardous substances from the electronic products entering the EU market (*Sarah et.al, 2008*). The graphical representation showing the sharp reduction of the six RoHS substances (Pb, Cd, Hexavalent chromium, Hg, PBB and PBDE) in three products namely PC (Fig. 1), Mobile (Fig. 2) and TV (Fig. 3) are shown.

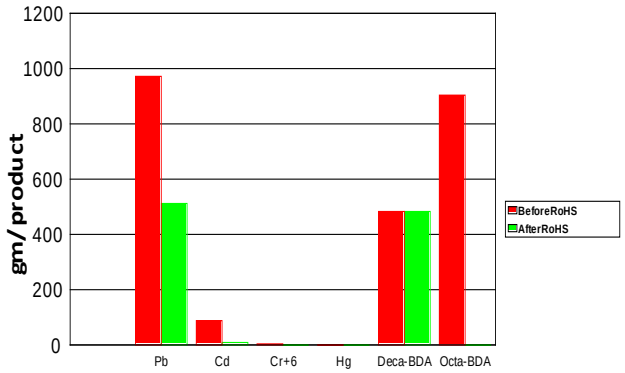

Fig.1: PC: Impact of RoHS Directives in EU

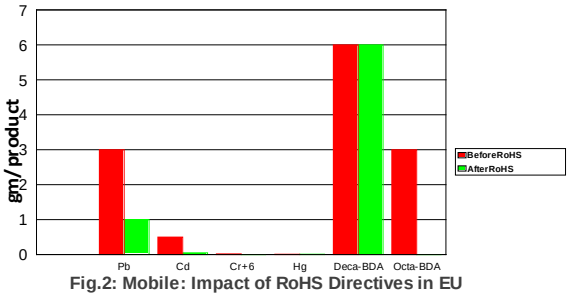

Fig.2: Mobile: Impact of RoHS Directives in EU

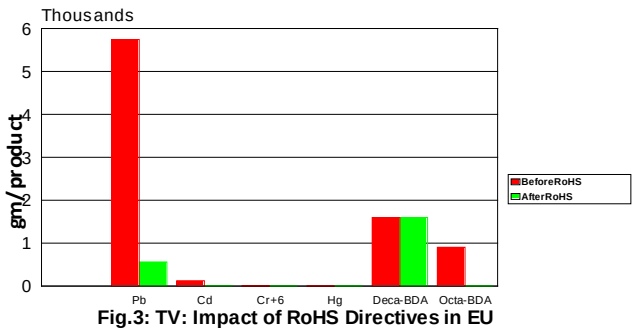

Fig.3: TV: Impact of RoHS Directives in EU

V. RoHS Regulation in India

Ministry of Environment and Forest (MoEF), Government of India is the nodal agency to address the issue related to RoHS and Electronic waste. MoEF has notified (S.O. 1035) the electronic wastes (Management and Handling) Rules, 2010 on 12th May 2011 to address the safe and environmentally friendly handing, transporting, storing, recycling of electronic waste and also to reduce the use of hazardous substances during manufacturing of electrical and electronic equipments (*source:http://moef.nic.in/downloads/rules-and regula - tions/1035e_eng.pdf)*. These are the first ever-exclusive rules on electronic waste in India. The chapter V of the rules has covered the reduction in the use of hazardous substances (RoHS) in the manufacture of the electrical and electronic equipments. These rules have been enacted from 1st May 2012 and rules relating to RoHS will come into effect from 1st May 2014.

The electronic wastes (Management and Handling) Rules, 2010 address reduction in the use of hazardous substances in the manufacture of electrical and electronic equipment. Following are the directives:

- Every producer of electrical and electronic equipment (see Table 1) shall ensure that, new electrical and electronic equipment do not contain lead, mercury, cadmium, hexavalent chromium, polybrominated diphenyls or ethers: Provided that a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury,
- hexavalent chromium, by weight in homogenous materials for cadmium shall be permitted.
- The list of applications exempted from provisions of the rule is provided in Schedule-II (*p37 of rule, Source:http://moef.nic.in/downloads/rules-and-regulations/1035e_eng.pdf*).
- The components of electrical and electronic equipment manufactured or placed on the market six years before the date of commencement of these rules are also exempted.
- In the event of a reduction in the hazardous materials used in the electrical and electronic equipment, the detailed information on the constituents of the equipment, need to be provided in the product information booklet.
- Imports or placement in the market for new electrical and electronic equipment, which are compliant to rule, shall only be permitted.
- Manufacture and supply of electrical and electric equipment used for defence and other similar strategic applications shall be excluded from the rule.
- Such reduction in use of hazardous substances in manufactured or imported electrical and electrical equipment shall be achieved within a period of two years from the date of commencement of these rules.

The electronic wastes (Management and Handling) Rules, 2010 cover various electronics and hardware products and telecommunication equipment. These are given in Table1.

Table 1 : Electronics, hardware products and telecommunication equipments covers in electronic waste rule 2010

Categories	Items
Electrical and electronic equipment/ Information technology and telecommunication equipment	• Centralized data processing, • Mainframes, • Minicomputers, • Personal computers, • Laptop, • Notebook, • Notepad, • Printers including cartridges, • Copying equipment, • Electrical and electronic typewriters, • User terminals and systems, • Facsimile, • Telex, • Telephones, • Pay telephones, • Cordless-phones, • Cellphones, and • Answering systems.
Consumer electrical and electronics products	• Television sets, • Liquid crystal display, • Light emitting diode display, • Refrigerator, • Washing machine, and • Air-conditioners.

VI. RoHS Testing Facility in India

a) Private Initiatives

Indian electronic and hardware industries had been facing a problem in exporting electronic products to EU countries since the implementation RoHS Directive of the EU in 2004. The problem is getting more pronounced, day-by-day, as the similar legislative measures are being adopted in most of the developed countries. India has limited testing facilities or laboratories. Adequate infrastructures, dedicated to the RoHS test, skilled lab manpower and scientific and technical knowledge base are rarely available. The demand and opportunities were emerging in Indian market for testing facilities and infrastructures and certification for RoHS compliance. Thus, several private laboratories had initiated RoHS testing to avail the timely opportunities as well as to address the needs of the industry. Table 2 provides few such laboratories and their facilities

Table 2 : List of NABL Accredited Private Laboratories involved in RoHS Testing and Certification in India

S.No.	Name & Address of Laboratories	Facilities Available
1	Bangalore Test House (BTH), Marrenahalli, Vijayanagar, 65,20th Main, Bangalore, Karnataka,	UV-VIS, AAS & GC-MS
2	Sargam Labs. Pvt. Ltd., Laboratory Service Division, 2, Ramavaram Road, Manapakkam, Chennai	ICP-MS, AAS, IC, EDXRF, GC-MS & UV-VIS
3	TUV-Rehinland India Pvt. Ltd.,Plot No. 17B, Electronic city, phase-II, Bangalore	ICP-MS, AAS, IC, EDXRF, GC-MS & UV-VIS
4	Hiram Institute For Industrial Research, 14-15, Sadarmangala Industrial Area, Whitefield Road, Bangalore	ICP-MS, AAS, IC, EDXRF, GC-MS & UV-VIS
5	Delhi Test House,A-62/3, G.T.Karnal Road, Opposite Hans Cinema, Delhi	ICP-MS, EDXRF, & UV-VIS
6	Shiva Analyticals (India) Ltd.,Plot No.24 D [P] & 34 D, KIADB, Industrial area, Hoskote, Bangalore	ICP-MS, AAS, IC, & UV-VIS
7	The Automotive Research Association of India, Survey No. 102, Vetal Hill, off Paud Road,Kothrud, Pune	UV-Visible
8	Geo-Chem Laboratories Pvt Ltd.,36, Raja Industrial Estate, Purushottam Kheraj Marg, Mulund (W), Mumbai	ICP-MS
9	Arbro Pharmaceuticals Ltd.,4/9, Kirti Nagar, Industrial Area, New Delhi	ICP-MS
10.	Doctors Analytical Laboratories, Priangut Road, Bhukum, Pune	AAS

The Table 3 provides the charges of the specific test in various private laboratories in India.

Table 3 : RoHS analysis charges at NABL accredited Private Laboratories in India

S. No	Laboratory	Analysis details	Tentative Testing Charge (US$)*
1	Shriram Institute, Bangalore	Pb, Cd, Cr^{6+}, Hg, PBB & PBDE	227
2	Delhi Test House, Delhi	Pb, Cd, Cr^{6+}, Hg, PBB & PBDE	125
3	Bangalore Test House, Bangalore	Pb, Cd, Cr^{6+} & Hg	35
4	Geo-Chem laboratories, Mumbai	Pb, Cd, Cr^{6+} & Hg by ICP-OES	56
5	Lucid Laboratories, Hyderabad	Pb, Cd, Cr^{6+} & Hg by ICP-OES	50
6	SGS, Chennai	Pb, Cd, Cr^{6+} & Hg by ICP-OES	82
7	Arbro, Pune	Pb, Cd, Cr^{6+} by ICP-MS	50
8	Doctors analytical laboratories, Pune	Pb, Cd, Cr^{6+} by AAS	32

NB : Charges mentioned are only indicative, and subject to change from time to time and vary depending on the complicacy of the test above. This is only to give an idea of the cost involved in the RoHS tests.

b) Government Initiatives

Though, private facilities are available, creating a well-equipped government facility was always a demand in India from the manufacturing industries for bringing transparency and neutrality of the test report. It was also felt that RoHS testing requires adequate research base, knowledge and technical skills, which would only be available and sustained by government owned laboratories. It was also stressed that the government can appropriately ensure International Standard like IEC (International Electrotechnical Commission).

Department of Electronics and Information Technology has therefore created a facility of the RoHS at Centre for Materials for Electronics Technology (C-MET), Hyderabad, which is one of the premier R&D institutions in the country under this Department. C-MET is the leading organization for the development of electronics materials, high purity metals, and electro-ceramics. The laboratory has robust R&D infrastructure facilities to carry out high-end research and development projects. This facility is the only government owned laboratory, which has obtained the accreditation from the National Accreditation Board for Testing and Calibration Laboratories. The laboratory is fully equipped with world recognized analytical equipments for RoHS testing. The international standard procedures are followed for the testing. Installed equipments are inductively coupled plasma-mass spectrometer (ICP-MS), ion chromatography (IC), gas

chromatograph – Mass spectrometer, energy dispersive x-ray fluorescence spectrometer (EDXRF), atomic absorption spectroscopy (AAS), UV - Vis - spectrophoto meter.

In the following section, working principle and functioning of these equipments are discussed.

i. *Testing equipments for RoHS analysis in CMET, Hyderabad.*

a. Energy Dispersive X-ray Fluorescence spectrometer (EDXRF)

The Energy Dispersive X-ray Fluorescence Spectrometer (Model: ARL QUANT "X", Thermo Scientific, Japan) has been installed at CMET, Hyderabad for testing hazardous elements. The EDXRF uses non-destructive technique and multi-elemental analysis with excellent sensitivity. This prerequisite instrument decides the pass or fails RoHS elements like Pb, Cd, Hg, all Cr ions and Br in part per million (ppm) levels. The equipment provides the accurate and fast analysis with mapping facility. The existence of hazardous substances can be confirmed in liquid, solid or film by screening of the samples at EDXRF.

b. Atomic Absorption Spectrometer (AAS)

C-MET, Hyderabad has installed the Atomic Absorption Spectrometer (Model: GBC 932 AA, GBC Scientific Equipments P. LTD, Australia) for elemental analysis at ppm level with reasonable accuracy and precision. The principle of AAS is the absorption of light by a free atom in the gaseous state to determine the concentration of a particular element qualitatively and quantitatively. AAS requires standards with known analyte content to establish the relation between the measured absorbent and the analyte concentration using Beer-Lambert Law. The radiation flux with and without a sample in the atomizer is measured to calculate the concentration or mass. The detailed analysis of three elements of RoHS i.e. Pb, Cd & Cr can be made by dissolving the given samples (0.2g) in certain acids by using Microwave Digestion System.

c. Inductively Coupled Plasma- Mass Spectrometer (ICP-MS)

Inductively Coupled Plasma- Mass Spectrometer (Model: X Series 2, Thermo Fisher Scientific Wissenschaftliche Gerate GmbH, Austria) has been installed at C-MET, Hyderabad. ICP works on the principle of atomic emission spectrometry. The instrument executes multi- elemental analysis with excellent sensitivity and high sample throughput. ICP-MS employs plasma as the ionization source and a mass spectrometer analyzer to detect the ions produced. It can simultaneously measure most elements in the periodic table and determine the concentration down to the sub monogram-per-liter (nag/l) or part-per trillion (ppt) level. It can perform qualitative, semi-quantitative, and quantitative analysis, since it employs a mass analyzer.

d. Ion Chromatography (IC)

The Ion Chromatography (Model: 850 Professional IC, Metrohm AG, Switzerland) has been installed at C-MET, Hyderabad to primarily analyse hexavalent Chromium at lower levels. Ion Chromatography is the only technique that C-MET can provide quantitative analysis of anions/citations at the ppb level. IC determines ions in liquids and ionic contamination on the surfaces of wafers, chips, and packages. Aqueous solutions, required for filtration, dilution, and/or cleaned to remove interferences, are used for analysis. Plastic samples are extracted with water/organic solutions to remove ions from the sample surface. IC analyzes Hexavalent chromium in any plastic sample.

e. UV-Vis Spectrophotometer

C-MET, Hyderabad has installed UV-Visible Spectrophotometer (Model: UV 2450, Shimadzu, Japan) to evaluate hexavalent Chromium in RoHS samples. The Cr^{6+} is extracted by using UV-VIS with hot water extraction technique. A beam of light from a visible and/or UV light source (collared red) is separated into its component wavelengths by a prism or diffraction grating. Each monochromatic beam in turn is split into two equal intensity beams by a half-mirrored device. One beam, the sample beam, passes through a small transparent container (curette) containing a solution of the compound being studied in a transparent solvent. The other beam, the reference, passes through an identical curette containing only the solvent.

f. Gas Chromatography – Mass Spectrometer (GC-MS):

C-MET, Hyderabad has procured Gas Chromatography – Mass Spectrometer (Model: DSQ II, Thermo Fisher Scientific Wissenschaftliche Gerate GmbH, Austria) to determine the brominated flame retardants. The difference in the chemical properties between different molecules in a mixture will separate the molecules as the sample travels the length of the column. The mono to deca congeners of both PPB and PBDE is analyzed in the given plastic samples by extracting these two components by using a Soxhlet extractor and preconcentrator. The mass spectrometer will quantify the concentrations of PBB and PBDE in plastics.

ii. *Testing Procedure*

During the RoHS testing and investigations of electrical and electronics products, following definitions are considered in choosing the materials.

a. Unit

It is the smallest part of electrical or electronic equipment that can be separated from the original products by using ordinary tools, without destroying the function of the part when it is removed.

b. Mechanically Disjointed:

It is the dismantled unit by simple processes such as screwing, disconnecting and/or de-soldering, or using ordinary tools. These materials are free from application of chemicals, cutting, grinding and/or polishing or destroying the function of the unit.

c. Homogeneous Material :

A homogeneous material cannot be 'mechanically disjointed' into different materials. 'Mechanically disjointed" means that the materials cannot in principle be separated into other materials by mechanical methods such as unscrewing, cutting, crushing, grinding or abrasive processes

The procedures followed in testing the RoHS samples are very rigorous and requires a lot of training, skill, and research. International standard practices such IEC (*International Electrotechnical Commission*) are followed in choosing materials, preparing the samples and the steps to be followed for particular RoHS test etc. During the RoHS testing and investigations of electrical and electronics products, step-wise procedures are followed by the regular RoHS test, which are shown in the Fig.4.

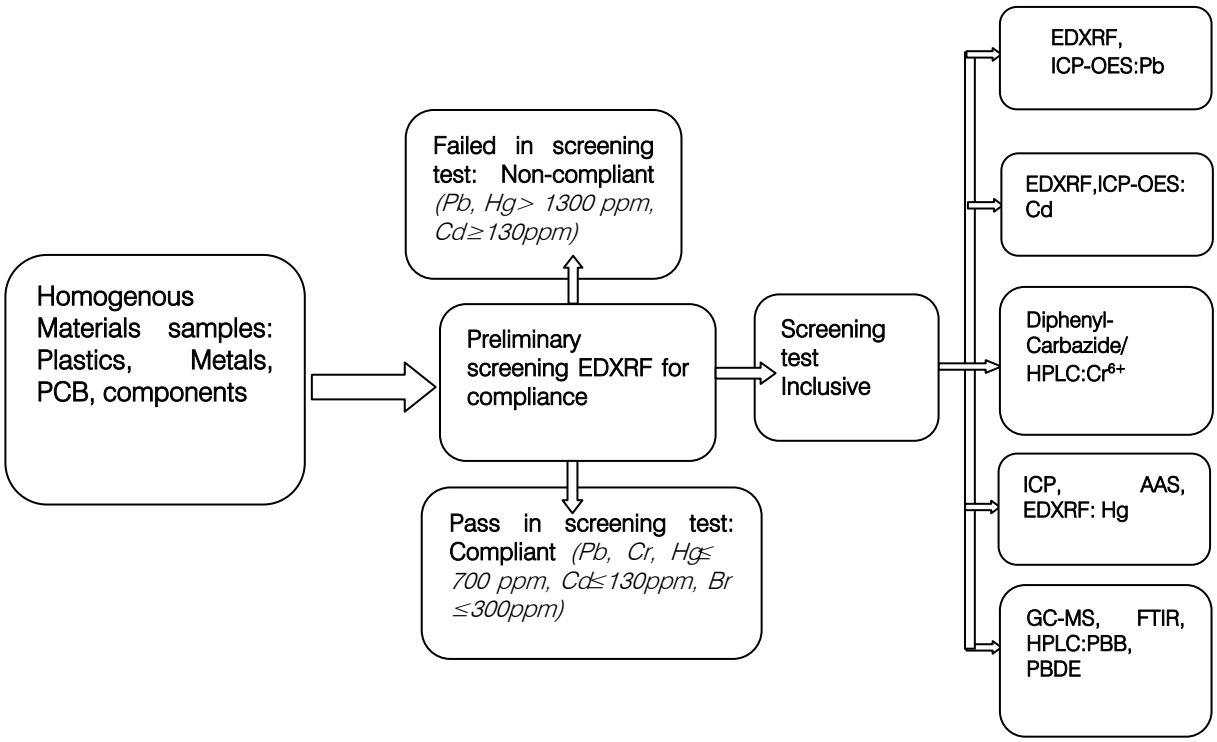

Fig.4 : Steps of RoHS samples test

iii. *Testing charges*

The analyzing of the RoHS samples from the electronic components, modules and electronic products requires specialized skill and expertise. Internationally recognized methods and standard are used to prepare the samples and test procedure.

The choosing of samples, preparation of the appropriate sample, correct analysis using standard methods etc. requires lots of research, study and knowledge base. Considering the consumables, manpower, maintenance of equipment, electricity, and other utilities etc., Centre for Materials for Electronics Technology, Hyderabad has decided test-wise charges, which are shown in Table 4.

Table 4 : Testing charges for RoHS analysis in C-MET, Hyderabad

S.No	Name of the equipment	Analysis details	TentativeTestingCharge (US$)
Quantitative Analysis			
1	GC-MS	PBB, PBDEs	68
2	ICP-MS / AAS	Pb, Cd, Cr^{6+}, Hg	45
3	IC/UV-Vis	Pb, Cd, Cr^{6+}, Hg	45
Qualitative Analysis			
4	EDXRF	Scanning for all RoHS elements	34
5.	Test of all six RoHS (Pb, Cd, Cr^{6+}, Hg, PBB and PBDE) in particular sample	Analysis of Pb, Cd, Cr^{6+}, Hg, PBB and PBDE content	34
6.	Scanning charges for all RoHS elements		34

NB : Charges mentioned are only indicative, and subject to change from time to time and vary depending on the complicacy of the test above. These are only to give an idea of cost involved in RoHS tests**.**

VII. Impact on Electronics Sector

a) Indian Electronic Industry

Indian electronics hardware production has been enhanced from US $ 12.4 billion in Financial Year 2005-06 to US $ 26.64 billion in Financial Year 2010-11 (*Source: Annual Report, DIT, Government of India, available at* http://www.mit.gov.in/sites/uploadfiles/dit/files/annualreport2010-11.pdf).

The size of the Indian electronics industry has been estimated to exceed $150 billion by 2015 and US $ 400 billion by 2020. Since the domestic production is less, most of the requirement is being met by imported products. The exports of electronic goods are expected to touch $15 billion by 2013-14. The share of electronics production in India's GDP has increased from 1.6 per cent in 2001-02 to 1.95 per cent in 2009-2010. A year-wise growth path of the Indian electronics industry is shown in Fig. 5.

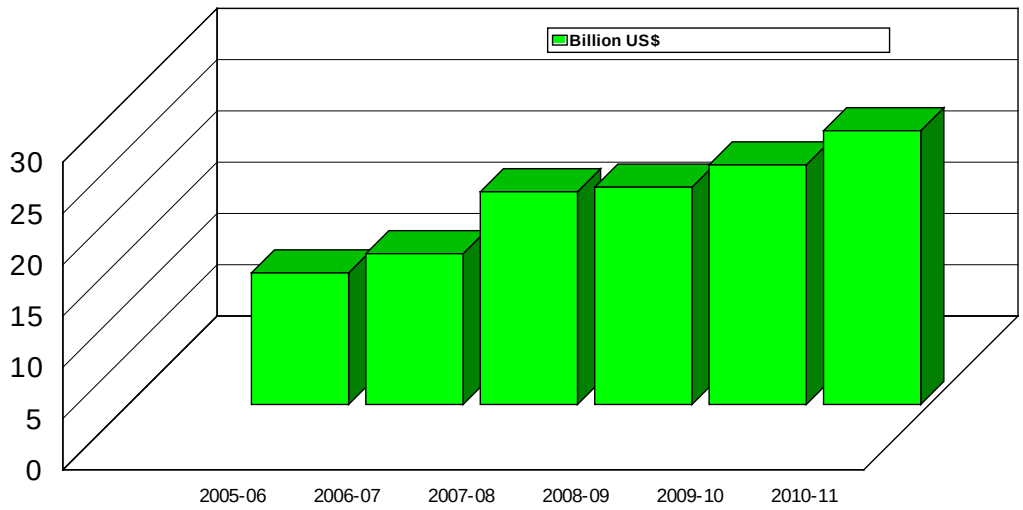

Fig.5: Indian Electronic Hardware Sector

The Indian electronics industry has faced a challenging phase since 2000 due to increasing debt, erosion of net worth, declining profits and low asset utilization. The industry is experiencing a stiffer level of competitions from foreign companies, which has strained the financial health. Though, the domestic demand of the electronic sector is enormously increasing, the Indian electronic manufacturing sector is not growing at that pace. India has substantial resources, capabilities excel the design, manufacturing and services sectors. India has established its presence in engineering, and IT enabled services sectors. India has not yet shown similar strength in manufacturing and design sectors, though, global electronics industries are ready to outsource their design work to Indian companies. The net profit margins for some of the India's largest electronic and consumer companies studied recently shows a very thin net operating level profit margins due to stiff competitions from domestic as well as foreign companies (see in Table 5).

Table 5 : Profit Margin of Leading Indian Electronic and Consumers Companies

S. No	Name of the companies	Domain Areas	Net Profit Margin (%) (Year 2010)
1.	Videocon Industries	Electronics goods manufacturing	5
2.	Moser Baer India Ltd	Optical storage, solar photo voltaic, consumer products etc.	4
3.	Samtel Group	Color and Black and White cathode ray tube, cathode ray tube glass, deflection yoke, etc.	<1
4.	Solectron	Frequency control products, hybrid micro circuit, etc.	<1
5.	Blue Star	Central air-conditioning	3
6.	Bajaj Electricals Ltd.-	Consumer electrical products	5
7.	Whirlpool India Ltd.	Consumer electrical products	4

Source : http://www.greenworldinvestor.com/2011/04/04/india-consumer-durables-stocks-consumer-discretionary-companies-a-good-play-on-rising-indian-middle-class/

b) RoHS Compliance: Operating Cost

Electronic components, modules and products manufacturing companies in China, Taiwan, Korea, Japan, as well as developed countries are incurring significant costs to make their products RoHS compliant. The cost includes administrative, monetary losses, technical and compliance charges etc. A survey finds that the initial RoHS compliance cost of the electronics industry was US $32 billion (*Buonpastore et. al, 2008*). The electronics industry is highly competitive and is reluctant to enhance prices to avoid losing market-share to a competitor. The possible costs on RoHS compliance *(Sarah et.al., 2008)* are briefly given below :

a. *Administrative expenses:* This includes the costs of training and information measures, personnel and resource expenses, costs of the collecting and reviewing information related to exemption procedures. The companies incurred cost for material declarations from suppliers and testing components for compliance etc. Stock management costs would increase as all products are not within the scope of the RoHS and also all markets do not have RoHS-like legislation.
b. *Monetary losses:* This includes a decrease in turnover, temporary discontinuation of non-compliant products, discontinuation (destroying) of non-compliant products, delayed introduction of new products, and obsolete components.
c. *Enhanced manufacturing costs:* In some cases manufacturing cost would increase due to process change with new materials and the low production yield associated with new process.
d. *Technical costs:* This cost would include phasing out capital equipments used for six RoHS materials, operating expenditure, costs of R&D etc.
e. Compliance costs: This includes testing, certification, auditing, for obtaining RoHS compliance certificates etc.

Several studies have been conducted to know the actual economic impact on the electronic sector due to implementation of RoHS. A study has projected that RoHS complying cost including R&D and capital expenditures for the large sector is nearly 1.9% of annual revenues or turnover. Similar costs for small and medium enterprises are considerably higher at 5.2%. The future ongoing costs of complying with RoHS are estimated at 0.4% of annual revenues, whereas, the estimation for the small and medium sectors have a substantially higher future cost (*Wurzman et. al.* 2005).

Few case studies are also made to know the cost impact of technological change. It has been found that lead-free solder costs approximately twice that of earlier cost. RoHS compliant materials contain costly metals like silver and gold and also needs an increased rate of recycling. Manufacturing cost has also increased due to high failure rates of lead-free components during the manufacturing process. The new compound also requires more re-work and repair, and higher energy cost (nearly 19%) due to its high melting point. Thus productivity decreases by 2 to 7%.

c) RoHS Compliance: Product Cost

A study on RoHS compliance readiness survey was conducted in China, Taiwan, Hong Kong and South Korea during 2005 by Global Sources. The studyobserved that the price of most of the electronic products have been enhanced between 5-10% in order to comply the RoHS directives. The details are given in Table 6.

Table 6 : Price Rise due to RoHS

Electronic Products	Percentage Rise (%)
Car electronics	5
Batteries	No significant change
Colour TVs	< 5
Computer peripherals	< 5
Computer systems and components	10
Connectors	10
Home a/v products	< 5
LEDs and LED displays	10
Media players and recorders	< 5
Networking products	No significant change
Passive components	< 5
Personal electronic devices	10
Printed circuit boards	< 5
Telecom products	< 5

VIII. Conclusion: India Scenario

India is a growing consumer market. Though, India is not a manufacturing base; mostly products are imported from the countries like China, Taiwan, and Malaysia etc. India has very limited companies involved in manufacturing and core design. The basic needs of these sectors are the capabilities of leading edge technology and availability of local markets. The present situation is conducive in both ways for the growth of India's design and manufacturing sectors. The manufacturing units, however, procure components, semiconductor ICs etc. mostly from neighbouring countries.

The present RoHS rules in India will have a significant impact on the business of electronics products. Indian industry need now to procure the components, modules and other peripheral items, which do not contain restricted chemicals to obey the RoHS rules. The industry would be affected due to the rules, as they would be responsible for dumping of hazardous substances. Presently, India is a major market for the non-compliant products. The electronic and hardware sector in India are mainly assembling and trading units. Every electronics and electrical units now need to abide by the electronic waste rule in India and therefore would force to procure components, modules, products, which are strictly complied with the rule. It would be very difficult for the Indian industry to meet the criteria in the near future as the industry works with very competitive and thin profit margins.

The alternative components, modules and products will be expensive. Extensive R&D is needed to find suitable alternative substances, providing the same functionality and reliability as the banned substances. Elimination of specific substances requires a great deal of research and development of alternative substances, which needs investment of time and resources of electronics manufacturers throughout the supply chain. This effort is technically challenging and sometimes unfeasible due to the complexity of electronic products. The technological know-how on the green electronics of RoHS compliant substances is available with developed countries. The technology cost is substantially high due to the involvement of major fund requirement for research and development. In order to honour the rule, the manufacturers need to make products with RoHS compliant substance, which result in increased costs. The manufacturer will defiantly pass on additional cost to the consumer. These additional costs and technical challenges would make it very difficult for Indian manufacturers to compete globally. This change would not only affect the electronics industry, but also other industry like electrical, power, telecommunication, automotive etc. where electronic products are used.

Similar to the case study of the global electronic sector discussed *at Para VII (b)*, it can be projected that the RoHS compliance cost for Indian electronic companies would also enhance between 1.9% to 5.2% of annual revenues or turnover, depending on the size of the industry (large/medium/or small). Procurement of alternative materials for the components would definitely be costlier. The import cost of the components and modules for most of the Indian companies would be high, being assembly unit. This higher import cost would further strain their operating profit. There will be a substantial rise in bills of materials for meeting the RoHS compliant products. The net profit margin of the local companies (Table 5) would further fall and in some cases would be difficult to sustain.

Indian exporters of electrical and electronic equipments are already experiencing these hurdles due to EU's RoHS directives since 2006. They have already ensured the compliance of the RoHS directive while is exporting their products to European countries. All of

reduced to the permitted concentrations from the electrical or electronic products that are being sold to the countries where the law is enacted. Since the product price in the European market is higher than that of the domestic market, absorbing the additional cost for the European market became easier. It would be, however, difficult for the Indian industry to prepare for the domestic market.

If one thinks long term, the environmental sustainability of any product would be ideal. Though, the cost involved in switching over RoHS compliant products is substantially higher, the country without RoHS legislation would, however, face greater risks economically. Most of the major world markets are or will be covered by RoHS like initiatives. Innovative electronics manufacturers would face a barrier to growth when looking at the market, where RoHS compliance is compulsory. Non-compliant imported products would drop in price as the global market for non-compliant products shrunk putting further pressure on locally produced products. Moreover, the loss of exports due to lack of knowledge of RoHS amongst the companies is more prevalent amongst SMEs. Many global manufacturers stress an international standard or centralization to simplify and streamline all the environmental related laws for electronic products.

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the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

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9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. **Pick a good study spot:** To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be

sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to

shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
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- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic

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Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

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The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

apparatus · 10
attributed · 5, 14, 18
Automobiles · 7
automotive · 23, 21
Azadirachta · 12

B

Buonpastore · 18, 23

C

California · 6
Concentration · 2
conducted · 2, 19
conductivity · 2, 4, 5
Consequently · 12
constituents · 2, 6, 10
contamination · 15

D

declining · 17
demonstrations · 11
development · 2, 22, 4, 12, 21
downstream · 4, 5

E

economically · 22
Emperical · 6
environmental · 2, 8, 22, 6, 7, 22, 23
equipments · 22, 23, 4, 6, 7, 8, 9, 10, 12, 14, 18, 21
experiencing · 17, 21

H

hazardous · 22, 4, 6, 7, 8, 9, 10, 14, 20
hexavalent · 4, 6, 7, 9, 15
Hexavalent · 4, 8, 15
homogeneous · 9, 16

I

implementation · 8, 10, 19
Intelligence · 7
interferences · 15
investigations · 15, 16

L

Laboratories · 23, 12
legislation · 22, 4, 6, 7, 18, 22

M

manufactured · 7, 9, 10
Mosquitoes · 8
multilayer · 16
Munirathnam · 23

N

neighbouring · 20
nepetalactone · 11

O

observations · 11

P

permitted · 9, 10, 22
photosynthesis · 5
Physico · 1, 2, 4, 5, 6, 7
Phytochemical · 1, 8, 10, 12, 13
polybrominated · 5, 6, 9
preconcentrator · 15
provincial · 7

R

recommendation · 16
Refractivity · 1, 14, 16, 18, 19, 20, 21

responsible · 2, 8, 20

S

semiconductor · 20
significant · 2, 22, 18, 20
Spectrometer · 14, 15
stewardship · 7
Strategic · 1, 22, 24, 6, 8, 10, 12, 14, 16, 17, 18, 20, 22
strategies · 13
studyobserved · 19
substances · 2, 5, 6, 8, 22, 4, 6, 7, 8, 9, 10, 14, 20, 21, 22
sustainability · 8, 22

T

telecommunication · 23, 10, 21
terrestrial · 6
tropospheric · 14, 16, 18
Tropospheric · 1, 14, 16, 18, 19, 20, 21
typewriters · 10

U

unscrewing · 16

V

volunteers · 8, 10, 11, 12, 13

W

weighed · 16
Wissenschaftliche · 14, 15
Wurzman · 19, 23

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