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ANALYZING RELATIONSHIP BETWEEN STATIC CHARGES AND RELATIVE HUMIDITY

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ABSTRACT

The present study provides a relationship between humidity levels and built of static charge at different levels of temperature. It is often observed that one faces problem of electronic shocks during dry air conditions. The problem of electronic components damage are also frequent in such type of environment when the humidity is low and temperature is relatively high. In this study , an experiment has been conducted to examine the impact of humidity on the formation of static charges and how this relationship is affected at different temperature levels.

Keywords- *Static Charges, Relative humidity etc*

I. INTRODUCTION

The present study provides a relationship between humidity levels and built of static charge at different levels of temperature. It is often observed that one faces problem of electronic shocks during dry air conditions. The problem of electronic components damage are also frequent in such type of environment when the humidity is low and temperature is relatively high. In this study , an experiment has been conducted to examine the impact of humidity on the formation of static charges and how this relationship is affected at different temperature levels.

II. OBJECTIVE AND BASIS OF THE STUDY

Static charge is caused due to imbalance of electric charges within or on the surface of a material and remain in existence till it is moved away through an electric current or electrical discharge. Static charge can be created by rubbing one surface of any object with the surface of another object and pulling them apart. The static charge is developed because when two different materials are brought into contact and then separated, the electrons lying in the outer shell of one material may get transferred to fill gap of outer shells of the other material which leads to development of negative electrical charge which gains electron in this process and development of positive electrical charge which loses electrons due to rubbing phenomena. Since most of the matter are electrically neutral and have the same number of electrons as protons, they tend to have static charge after obtaining or losing extra electrons in the outermost shells of their atom. The electric field created due to excess of charges results in formation of the the static electric effects of attraction, repulsion or a spark. One can also produce static electric charge by pressing two materials together and pulling them apart but the process of rubbing them and keeping them apart is found to be more effective. The intensity of formation of static electric charge also depends upon the material being used. For example, rabbit furs are used to give up electrons for the purpose of any study as it has high tendency of losing electrons when rubbed on something and become positively (+) charged. Similarly, Teflon material is used to extract electrons as it has high tendency to become negatively charged (−) when rubbed. Therefore, for this study, rubbit furs and Teflon have been used for developing static charge on the required objects. It was observed under this study that the phenomena or the extent of static charge is not only a function of different materials but also depends on the relative humidity of the environment and tend to display different relations at different degrees of temperature.

III. PROCEDURE OF THE STUDY

In order to conduct the study, two inflated balloons tied with equal measurement of threads have been used. One balloon is fixed at one of the leg of the table whereas the other one was left free to rotate and move . The balloon which is left free is enveloped with teflon which is rubbed with rabbit fur to create static charge on its surface , the balloon is rotated is left free to interact with the fixed balloon. As when the balloon touches the fixed balloon, the time for which it remain contacted with the fixed balloon is observed and recorded. The time has been measured in millisecond using online time watch and the temperature alongwith the humidity has been measured using MCP digital room thermometer with humidity indicator and watch. The same procedure is repeated under different circumstances on different days and time to incorporate the varying level of humidity and temperature.

Hypothesis

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The null hypothesis in this study was that change in relative humidity does not significantly impact the formation of static charge on objects.

IV. READING S & OBSERVATIONS

The average humidity level and the maximum /minimum temperature observed during various months in the year 2015 near NCR region is given below it table1 :

Month of the year (2015)	RH (Relative Humidity)	Maximum temperature (in degree Celsius)	Minimum temperature (in degree Celsius)
January	63	18	7
Feb	55	22	10
Mar	47	29	22
Apr	34	36	22
May	33	39	26
Jun	46	38	27
July	70	34	26
Aug	73	34	28
Sept	62	34	26
oct	52	32	19
Nov	55	28	13
Dec	62	22	8

Table 1: Varying levels of Relative Humidity and Temperature over one year period

It can be observed from the above data that NCR region witnesses wide variation in humidity level which is maximum around the month of July and August whereas minimum during the period April and May. The trend of humidity and relative change in maximum / minimum temperature can be better observed from the figure 1 drawn below :

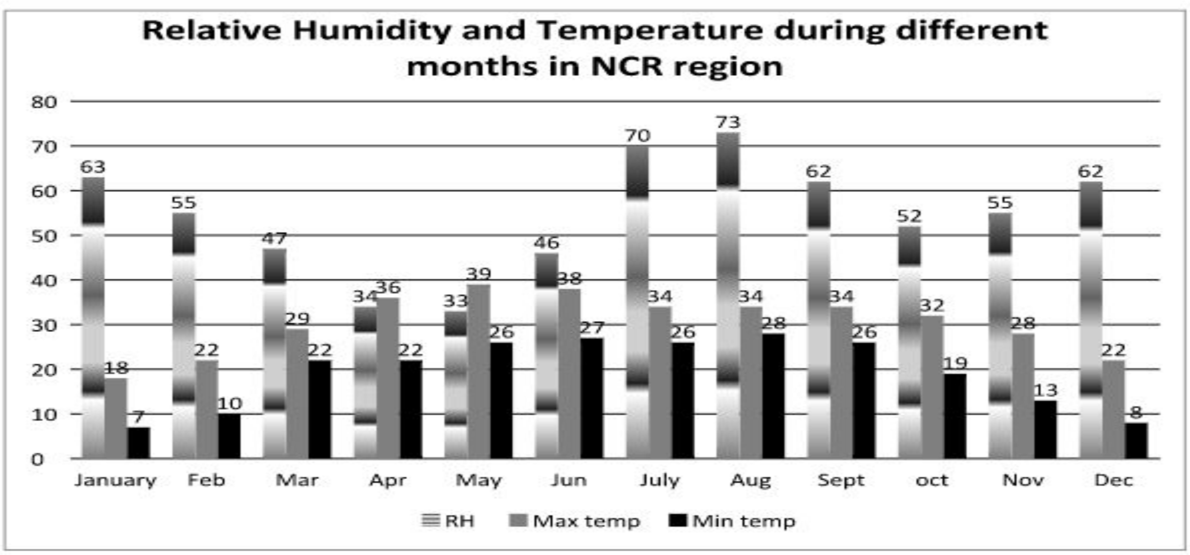

Figure 1: Chart showing trend of Relative Humidity and Temperature (Maximum and Minimum) over one year period.

The case of electronic component failures and electrical shocks, etc are also more prevalent during the periods when relative humidity levels are low as it facilitates in development of static charges. Although ten readings in all different months were taken but statistical test was employed for the figures obtained in the month of January (when RH level is around 63), April (when RH level is around 34), May (when RH level is around 33) and August (when RH level is 73). The observations with regard to time of contact measured in terms of milliseconds for different relative humidity levels are given below in table 2

S.N0	When RH 63 (Time in ms)	When RH 34 (Time in ms)	When RH 33 (Time in ms)	When RH 73 (Time in ms)
1	2058	4568	4788	1985
2	2645	4988	4721	1952
3	2356	4785	4736	1932
4	2741	4321	4715	1975
5	2611	4625	4698	1985
6	2689	4589	4688	1685
7	2754	4639	4692	1852
8	2564	4523	4836	2014
9	2588	4682	4751	1963
10	2685	4671	4823	1966
Average	2569.1	4639.1	4744.8	1930.9

Table2: Reading of Time period (in millisecond) for which one balloon remain contacted with the other balloon

From the data shown above , we can observe that for same level of rubbing effect and ensuring almost level of average temperature , the time for which the moving balloon remain in contact with the fixed balloon is different. The average time of contact was 1930.9 millisecond at RH level of 73 as compared to 4744.8 millisecond at RH level of 33. However, in order In order to test the hypothesis under study , one –way ANOVA test has been conducted on the data given in table 2. All the test have been conducted using 5% level of significance. For the purpose of inferring on the basis of ANOVA, the assumption of normality of data and homogeneity of variances has been checked using K-S test and Levene's test respectively. Finally, Post - hoc analysis using multiple comparison and mean plot has been used to find the areas in which differences are significant.

V. ANALYSIS OF DATA

The assumption of normality of data has been examined using one sample Kolmogorov-Smirnov test (K-S test) using SPSS. The result of the output are summarized below in table 3.

One-Sample Kolmogorov-Smirnov Test		
		RH
N		40
Normal Parameters[a,b]	Mean	3470.9750
	Std. Deviation	1266.00647
Most Extreme Differences	Absolute	.272
	Positive	.214
	Negative	-.272
Kolmogorov-Smirnov Z		1.720
Asymp. Sig. (2-tailed)		.005
a. Test distribution is Normal.		
b. Calculated from data.		

Table3: SPSS output of One sample Kolmogorov – Smirnov Test

As can be observed from above calculation , p-value (Asymp. Sig) is less than .05 , therefore, we can concluded that our data complies with the condition of normality . In order to test the homogeneity of variances among return , Levene statistic has been calculated using SPSS , as shown below in table 4:

Test of Homogeneity of Variances

RH

Levene Statistic	df1	df2	Sig.
2.030	3	36	.127

Table4: SPSS output of Levene statistic test

Since the Levene statistic is greater than 0.05 we therefore conclude that the variability among the time recordings are significantly different. This makes necessary to further employ usage of ANOVA test to find out if the time of contact between the balloon under different levels of humidity are significantly different or not. The output obtained using SPSS on the data given under table 1 , with regard to ANOVA test, is given below in table 5

ANOVA					
RH					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	61723556.675	3	20574518.892	944.066	.000
Within Groups	784566.300	36	21793.508		
Total	62508122.975	39			

Table 5: SPSS output of ANOVA test

It can be observed from the output that p value (Sig.) is less than .05 ,it implies our null hypothesis is rejected which means there is significant difference between time of contact of balloons at different levels of relative humidity. The difference among these value which have been observed can be concluded to have occurred due to different amount of static charges created on the surface of moving balloons.

VI. POST ADHOC TEST & ANALYSIS

The result obtained above shows that there is significant different among the various readings of time of contact under different level of relative humidity. In order to ascertain difference of each set of reading vis-à-vis other sets of readings , multiple comparison test was conducted and its output is given in table 6.

Multiple Comparisons					
Dependent Variable: RH Tukey HSD					
				95% Confidence Interval	
(I) Type	Mean Difference (I-J)	Std. Error	Sig.	Lower	Upper Bound

					Bound	
When RH 63	When RH 34	-2070.00000*	66.02046	.000	-2247.8081	-1892.1919
	When RH 33	-2175.70000*	66.02046	.000	-2353.5081	-1997.8919
	When RH 73	638.20000*	66.02046	.000	460.3919	816.0081
When RH 34	When RH 63	2070.00000*	66.02046	.000	1892.1919	2247.8081
	When RH 33	-105.70000	66.02046	.391	-283.5081	72.1081
	When RH 73	2708.20000*	66.02046	.000	2530.3919	2886.0081
When RH 33	When RH 63	2175.70000*	66.02046	.000	1997.8919	2353.5081
	When RH 34	105.70000	66.02046	.391	-72.1081	283.5081
	When RH 73	2813.90000*	66.02046	.000	2636.0919	2991.7081
When RH 73	When RH 63	-638.20000*	66.02046	.000	-816.0081	-460.3919
	When RH 34	-2708.20000*	66.02046	.000	-2886.0081	-2530.3919
	When RH 33	-2813.90000*	66.02046	.000	-2991.7081	-2636.0919
*. The mean difference is significant at the 0.05 level.						

Table 6: SPSS output of Multiple comparison test

As can be observed from the above table, except the case of (when RH 33 and when RH 34), in all cases sig. value i.e. p is less than 0.05 which mean , differences are significant. In case of (RH 33 and RH 34), the differences were not significant. The same behavior is also visible from the mean plot of the values shown in figure 2 .

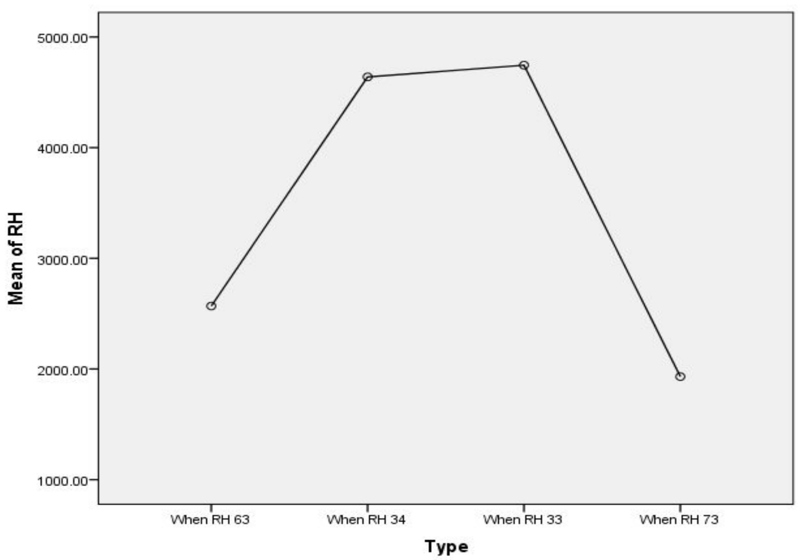

Figure 2: Mean Plot

VII. CONCLUSION

The readings to time contact reflecting the extent of generation of static charges observed during the experiments though appear to be different for different levels of relative humidity. However, to examine this fact , statistical test has been employed and it was found to be statistically different. The reason which can be attributed to lower generation of static charges at higher levels of relative humidity is the presence of moisture particles which helps in release of certain electrons from the charge created on one balloon through rubbing effect. Thus, presence of moisture content helps in prevention of electric shocks emanating due to static electricity.

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