RESEARCHERID
THOMSON REUTERS

[Shelke * *et al.*, 7(5): May, 2018]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

MECHANICAL PROPERTIES OF HYBRID GLASS/PLYWOOD REINFORCED EPOXY COMPOSITES

Astha Sharma[*1], DharamvirMangal[2]

[*1]Research Scholar, Mechanical Engineering Department, Gautam Buddha University, Greatter Noida (U.P.) India

[2]Assistant Professor, Mechanical Engineering Department, Gautam Buddha University, Greatter Noida (U.P.) India

DOI: 10.5281/zenodo.1241434

ABSTRACT

Application of composite materials is increasing these days in areas like aircraft engineering to automobile industry, ships etc. because of their unique properties. Fiber Reinforced Plastics (FRP) is used a lot in aerospace industries these days. They possess advantages like light weight, low cost, simple maintenance and corrosion resistance. FRP requires unique strength design methods, testing procedures, etc. Glass fibers have very less Young's modulus, shear modulus and Poisson's ratio reducing its strength. Carbon fiber has very good mechanical properties but it's very costly. Therefore in this research work, plywood is used instead of carbon because of its low cost, easy availability and good compressive strength. Hardwood is used in ply. Composite is prepared by hand layup method and both tensile and compressive tests are conducted on Universal Testing Machine (UTM). From the tensile and compressive tests, the value of Ultimate tensile strength and Flexural compressive strength of the composite material is achieved. Young's modulus increased as compared to glass fiber reinforced polymeric composite.

I. INTRODUCTION

Composite is prepared by combining two or more materials to enhance their individual properties. The main motive to do this is to reduce the negative properties of one material.There is no chemical combination between materials, they are just physically combined. One element is called matrix or base material and others are called reinforcements. When glass fiber reinforced polymer is used, Young's modulus is 24N/mm² [1]. Use of natural fiber is increasing rapidly in this field because of their cheap cost, easy availability, biodegradability, less harmful effects etc. In this research work, glass fiber is reinforced with plywood. Plywood is made up of hardwood as this material is to be used for construction purposes.Because of the poor mechanical properties of the glass fiber reinforced plastic material and high cost of carbon; natural fiber is used. In future, this structure can be used in construction of buildings. They can be used in roof work because of their high compressive strength. Wood is known for its good compressive strength, low cost and easy availability. Composite is prepared by hand layup method using epoxy resin. Layers of chopped glass fiber sheet are placed on the plywood. After the material is prepared, both tensile and compressive tests are performed on UTM. Graph is plotted against load and displacement and Ultimate tensile strength and compressive strength is calculated.

II. MATERIALS

Glass fibers material consists of B2O3, SiO2, Al2O3, MgO, or CaO .This material is made of very fine fibers of glass. It can be easily prepared by molding process. Chopped fiber glass sheets are used in this research work. Taking length of glass fiber between 3 to 25 mm. Fig. 1 shows the sheet of chopped glass fiber. Glass fiber has lower strength alone.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

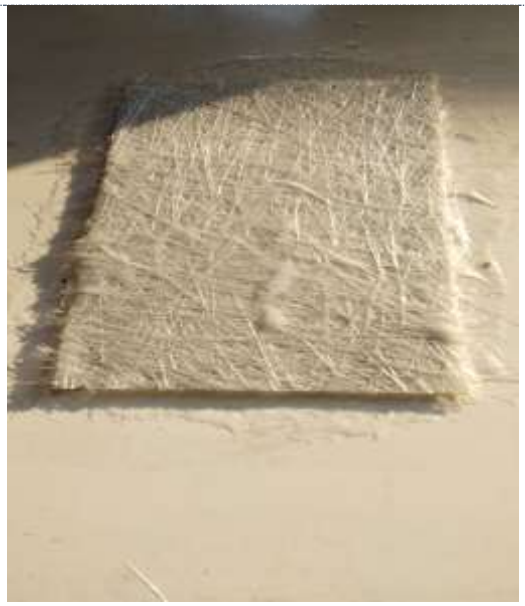


Fig.1 Sheet of chopped glass fiber

Plywood is used as the second material. Plywood is aligned longitudinally on this sheet. The properties such as good compressive strength, low cost, good chemical resistance and good strength to weight ratio, plywood is considered in the research work. In earlier tests carbon was used in place of plywood. But it was replaced in this test due to the cost factor.

Epoxy resin is used in the preparation of the hybrid composite is. Epoxy is the dried end product of epoxy resins and also a colloidal name of the epoxide functional group. Epoxy resins (poly epoxides) are a group of reactive pre polymers and polymers containing epoxide groups.

III. FABRICATION OF COMPOSITE

Hand Lay-up is a technique which combines layers of reinforced fiber with the resin. The process comprises the positioning of reinforcement material into layers. These layers are then soaked with a resin system either through a brush or roller to guarantee a good wet out of the reinforcement material. Both the chopped glass fiber sheet layer and plywood layer are placed by this process. Percentage volume of glass fiber and plywood is given in Table 1.

Table 1: Composition of hybrid material

Sr. No.	Types of layer	Percentage in hybrid
1	Glass fiber	65.57%2
	Plywood	34.43 %

Then it is soaked with the wet epoxy resin by pouring it on the fiber layers. The fiber layers and the wet epoxy resin are left to cool in the regular room temperature. We can keep the material at different temperature levels for the best temperature level to get excellent mechanical properties.Fig 2.and Fig 3. shows the preparation of composite material.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

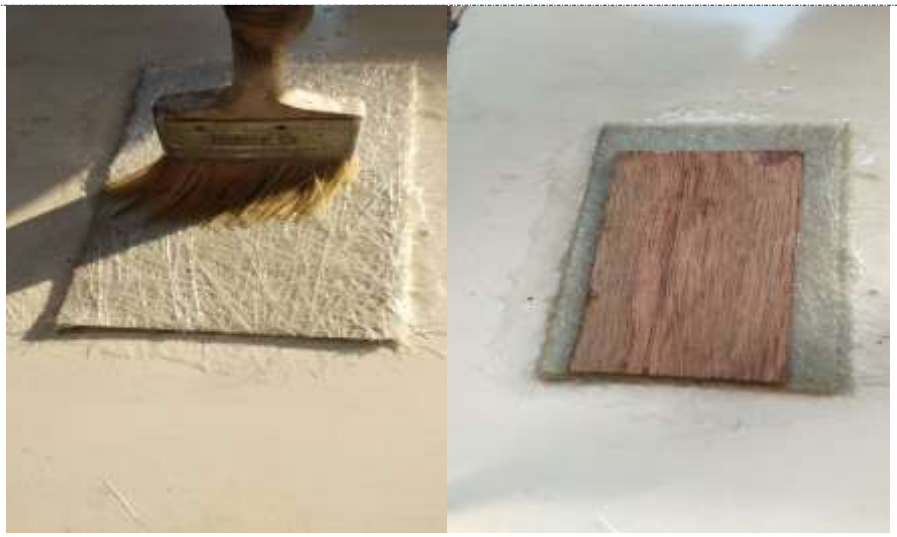


Fig 2. Application of epoxy on chopped Fig.3 Plywood placed on the glass fiber sheet Glass fiber sheet

IV. TENSILE TEST FOR HYBRID COMPOSITE

The specimen used in this study is cut from the rectangular sheet of thickness 6.1mm prepared by hand layup process. For the test purpose, the specimen is cut in dumbbell shape. The dimensions of the specimen are taken as per the Table 2.Fig 4.shows the specimen design. Fig 5.shows the original specimen and Fig. 6 shows the machine on which the experiment is performed.

Table 2: Dimensions of the specimen for tensile test(in mm) Total lengthGauge Length Width Thick Length of pipe

90 50 12.6 6.1 20

|<----------20mm---------->|<---50mm--->|<----------20mm---------->|

Fig.4 Specimen design

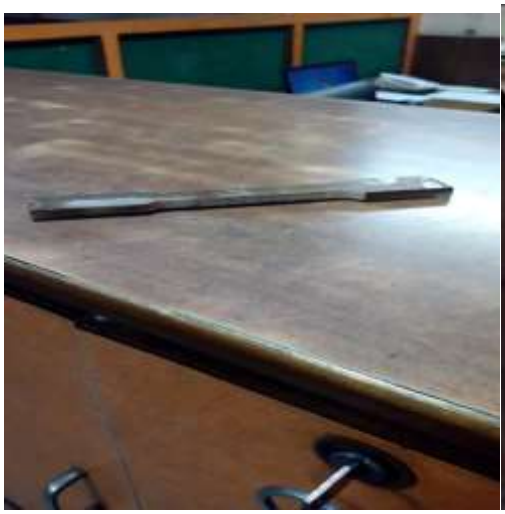


Fig 5.Specimen for tensile test

Fig 6. UTM on which test is performed

Testing machine with a capacity of 600 KN is used for the test. The results are shown in Graph 1.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

V. COMPRESSIVE TEST FOR COMPOSITE

Specimen with dimension 90× 53.5× 6.1(L×W×T) are used in this test. Load is applied keeping the surface with ply upward and the surface with glass fiber downward. Thus, glass fiber bears the tensile load and plywood is kept to bear the compressive load.Fig 7. Shows the specimen on which the test is performed.

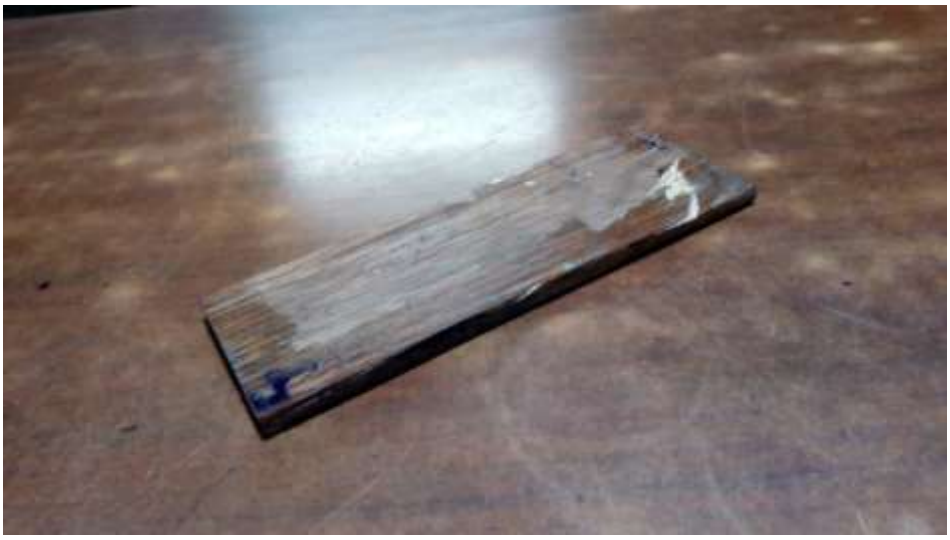


Fig 7. Specimen for compressive test

Final result is shown in the Graph 2.

VI. RESULTS AND DISCUSSIONS

As we know by now that composites are prepared so that some good properties can be achieved with the help of two different materials by making a physical combination between them. In this research work, tensile and compressive tests are done on the glass fiber composite reinforced with plywood. As a result of these two tests, following data is achieved. As mentioned in Table 3, Table4, Graph 1 and Graph 2.Fig 8.and Fig 9 shows the specimens after tensile and compressive tests respectively. Fig 10.is also an image of specimen after compressive test.

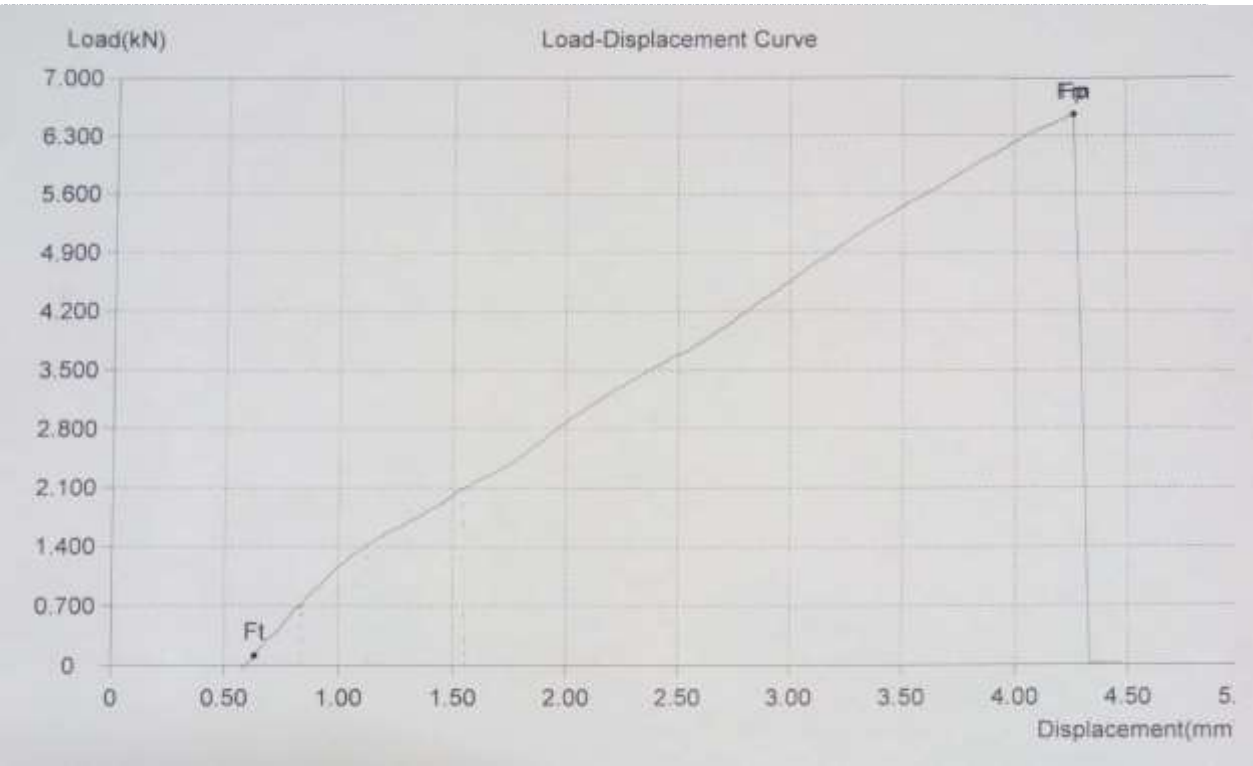
Table 3: Tensile test

Sr. No.	Parameter	Observation
1.	Cross sectional Area(mm²)	76.86
2.	Gauge Length (mm)	50
3.	Elongated Length (mm)	51.5
4.	Elongation (%)	3.0
5.	Ultimate Load (KN)	6.5
6.	Ultimate Tensile Strength (MPa)	85
7.	Young's modulus (N/mm²)	2845

Table 4: Compressive test

Sr.No.	Parameter	observation
1.	Width (mm)	53.5
2.	Thickness (mm)	6.1
3.	Length (mm)	90.0
4.	Ultimate Load (N)	1460
5.	Flexural Strength (N/ mm²)	99.0

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



Graph 1.Tensile Test

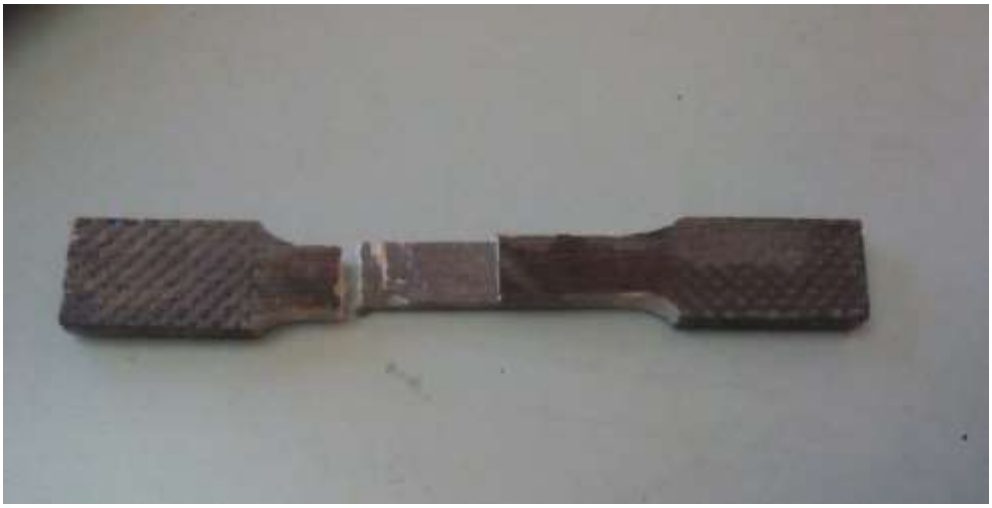
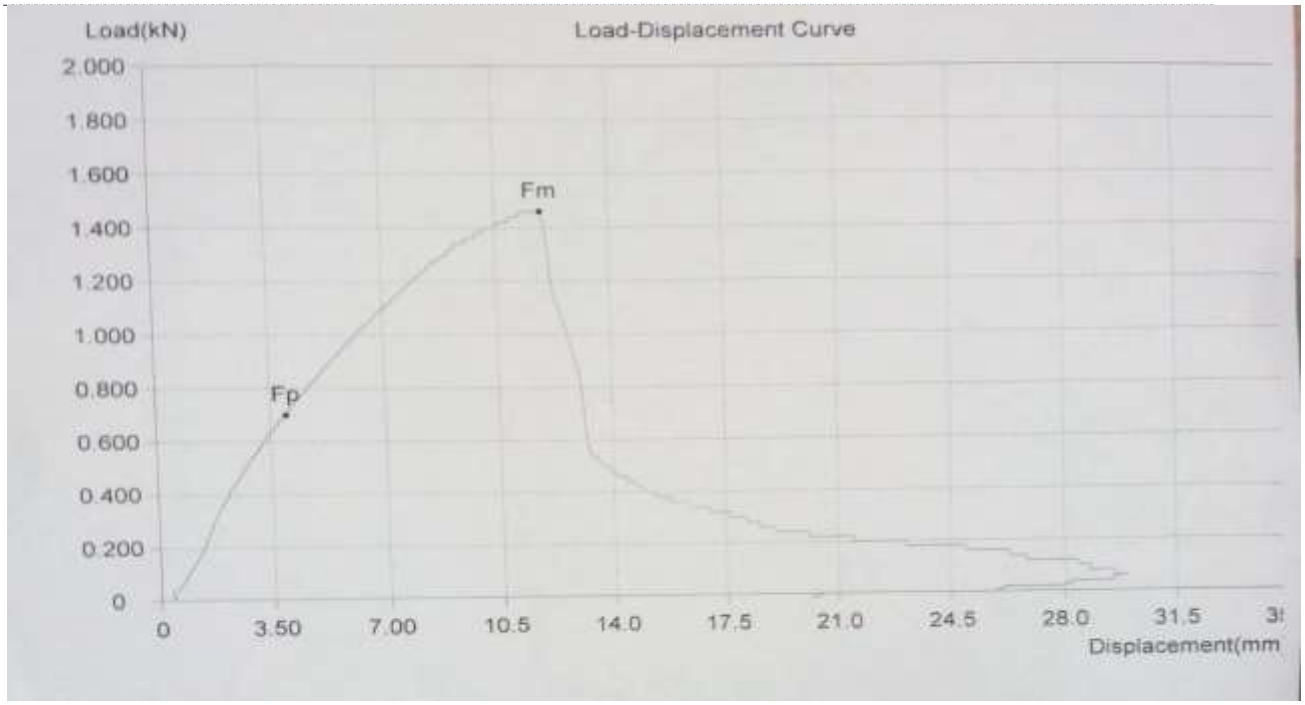


Fig.8 Specimen after the test

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



Graph2. Compressive test

Table 4: Compressive test

Sr.No.	Parameter	observation
1.	Width (mm)	53.5
2.	Thickness (mm)	6.1
3.	Length (mm)	90.0
4.	Ultimate Load (N)	1460
5.	Flexural Strength (N/ mm²)	99.0

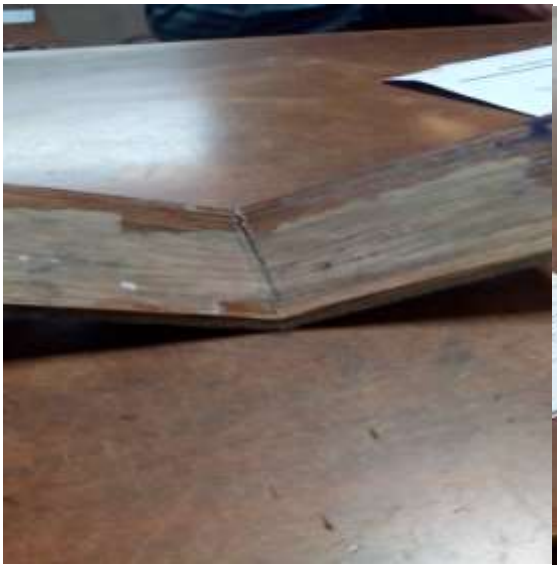


Fig 9. Specimen after test from wood side

Fig 10. Specimen after test from glass fiber side

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

VII. CONCLUSIONS

The system in both the tensile test and compressive test gave precise results. In the tensile test, the failure happened on the gauge length of the specimen showing that the holding specimen worked correctly. The Ultimate tensile strength and Flexural strength in both tensile and compressive tests were calculated respectively. Young's modulus was calculated using the stress and strain graph. Final value of young's modulus came out to be 2845N/mm². Whereas the original value of glass fiber reinforced polymeric composite was 24 N/mm². Thus, Young's modulus increased in a very excellent way in this material. Hybrid composites gave excellent mechanical properties. Therefore, it can be used where there is a need of good mechanical properties. The test set up iseasy to use. It is recommended to use more samples for clear results. Mixture of glass fiber and plywood will increase the strength and reduce the cost of the material as compared to glass fiber alone and glass fiber composite reinforced with carbon respectively. This structure can be used in the construction of roofs because of its good strength

VIII. REFERENCES

[1] Bhagwat P.M., Ramchandran M., PramodRaichurkar (2017) Mechanical properties of Hybrid Glass/Carbon Fiber Reinforced Epoxy Composites
[2] Sreekala M.S., George, J., Kumaran, M.G. and Thomas, S. (2002) The Mechanical Performance of Hybrid Phenol Formaldehyde-Based Composites Reinforced with Glass and Oil Palm Fibers. Composites Science and Technology, 62,339-353. http://dx.doi.org/10.1016/S0266-3538(01)00219-6
[3] Mishra, S., Mohanty, A.K., Drzal, L.T., Misra, M., Parija, S., Nayak, S.K. and Tripathy, S.S. (2003) Studies on Mechanical Performance of Biofiber/Glass Reinforced Polyester Hybrid Composites. Composites Science and Technology, 63, 1377-1385. http://dx.doi.org/10.1016/S0266-3538(03)00084-8
[4] Gowda, T.M., Naidu, A.C.B. and Chhaya, R. (1999) Some Mechanical Properties of Untreated Jute Fabric-Reinforced Polyester Composites. Composites: Part A, 30, 277-284. http://dx.doi.org/10.1016/S1359-835X(98)00157-2
[5] Kin-takLauabPui-yanHungaMin-HaoZhucDavidHuid https://doi.org/10.1016/j.compositesb.2017.10.038
[6] https://www.google.co.in/search?ei=c42NWrGVFYKd0gSWmoHgCg&q=young%27s+modulus++of+glass+fiber&oq=young%27s+modulus++of+glass+fiber&gs_l=psy-ab.3..0.17050.23948.0.24999.33.21.0.0.0.0.391.2862.0j1j5j4.10.0..2..0...1.1.64.psy-ab..25.8.2186...35i39k1j0i7i10i30k1j0i7i30k1.0.a4ZdTcmFkFU
[7] https://www.woodsolutions.com.au/wood-product-categories/plywood.

CITE AN ARTICLE

Sharma, A., & Mangal, D. (2018). MECHANICAL PROPERTIES OF HYBRID GLASS/PLYWOOD REINFORCED EPOXY COMPOSITES. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*, *7*(5), 176-182.