11 OKTOMVRI

EUROKOMPOZIT

Eco-Houses based on Eco-friendly Polymer Composite Construction Materials

COMPARATION OF KENAF FIBER COMPOSITES TO STRUCTURAL COMPOSITES PRODUCED BY "EUROKOMPOZIT "

V.Srebrenkoska

ISO 9001:2000

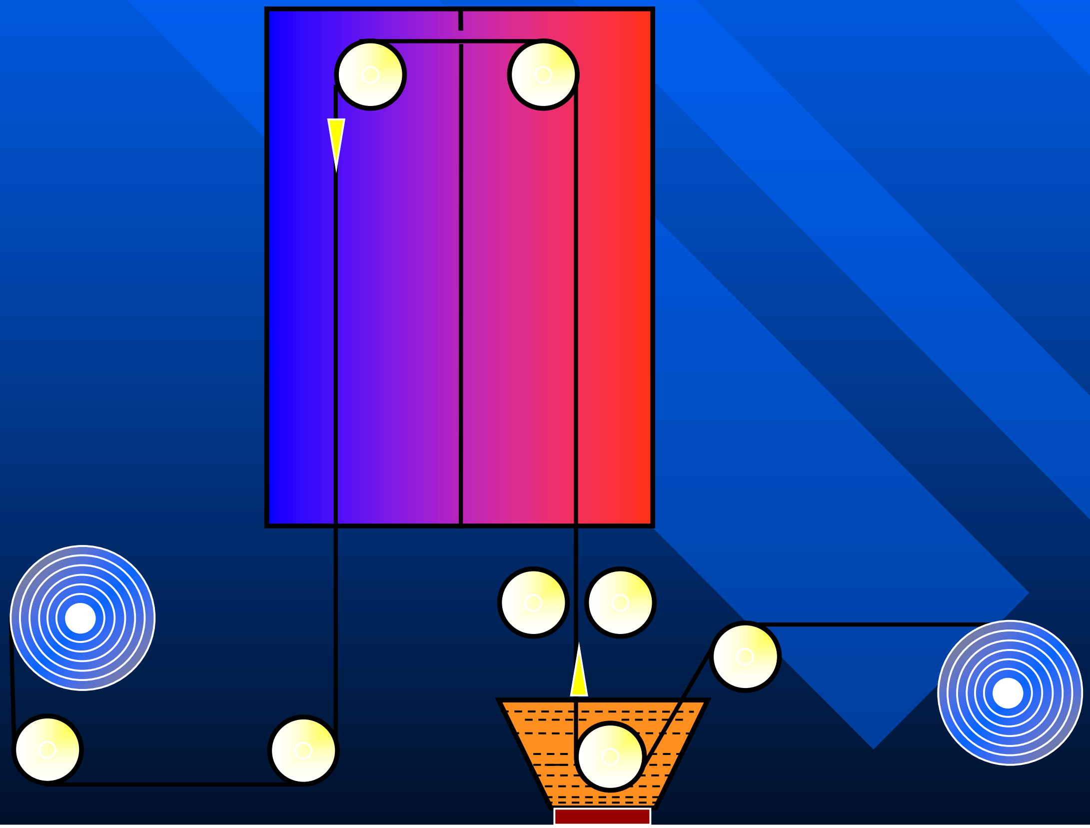
Composite materials, which are produced in "Eurokompozit"

- Composite materials containing cellulose paper as reinforcement and synthetic phenolic resin as matrix.
- Composite materials containing cotton fabric as reinforcement and synthetic phenolic resin as matrix.
- Composite materials containing glass fabric as reinforcement and synthetic epoxyde resin as matrix.
- Composite materials containing glass fabric as reinforcement and synthetic phenolic resin as matrix.

PRODUCTION OF PREPREGS

The reinforcement material used in the composites is impregnated with a resin when a preform prepreg is obtained. With the impregnation process a complete wetting of fibers with the matrix is performed lake a transparent film. In the prepreg itself the resin is transformed from A to B stages that is form liquid and soluble phase into a solid, partly melt able phase suitable for processing.

Basic parameters in the process of prepreg production are: content of matrix, uniformity of matrix along overall surface of reinforcement, gel time, matrix flow, moisture content and volatiles materials.



Bidirectional prepregs properties

Property	Unit	Paper based prepreg	Cotton based prepreg	Glass prepreg	Glass prepreg
Resin type		phenolic resin	phenolic resin	Epoxy resin	phenolic resin
Resin content	%	44	48	40	40
Volatiles content	%	1,5	1,8	1,4	1,5
Gel time at 150^{O}C	s	98	102	96	98
Resin flow	%	4,5	5,9	5,1	4,8

Kenaf fibers preforms properties

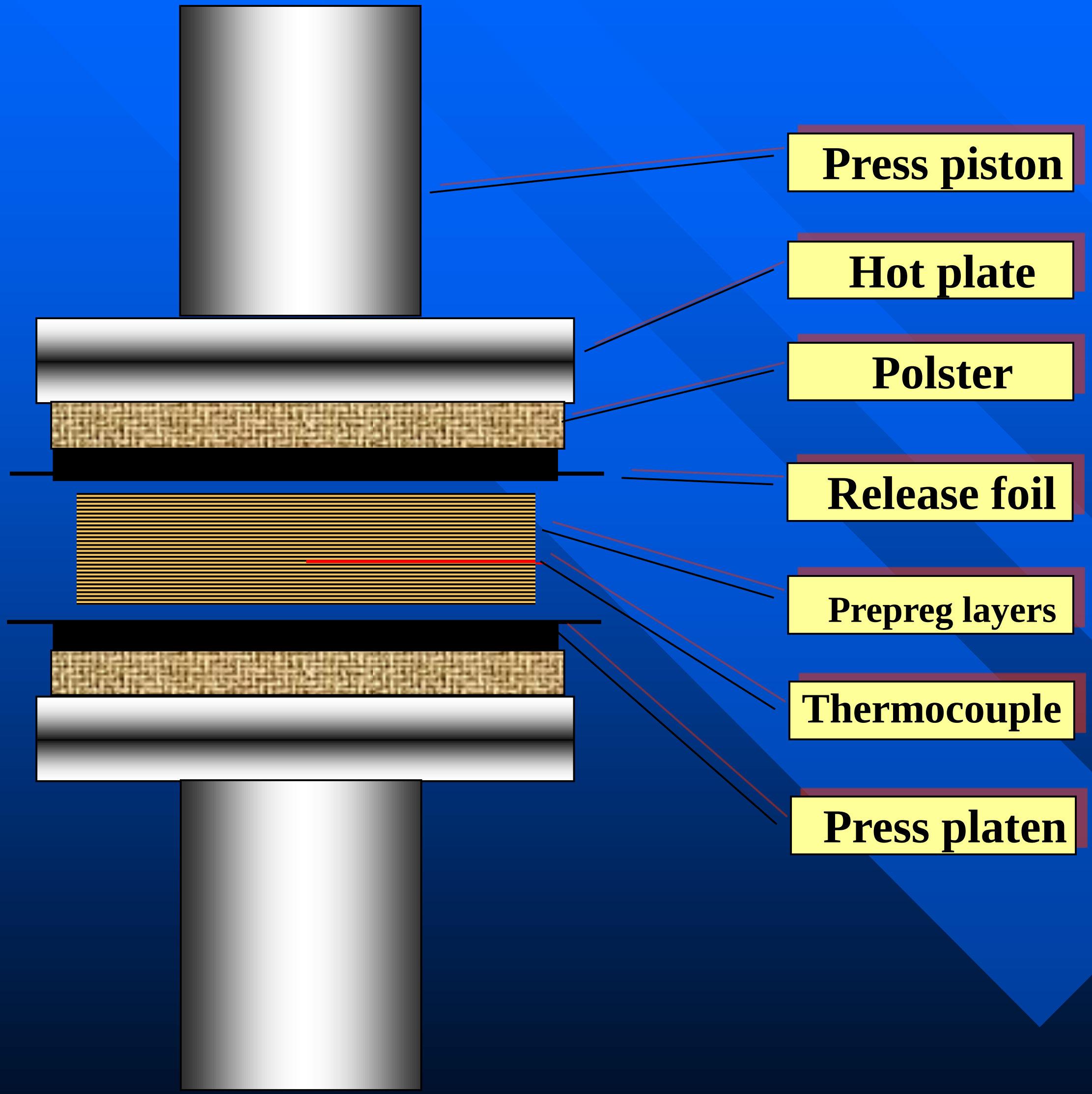
The available kenaf fibers samples, were delivered as preforms already impregnated with thermoplastic resins.
The properties of kenaf / biocomp (kenaf 80%, resin 20%) the preforms are given in the following table:

Property	Unit	Kenaf fibers preforms
Resin type		thermoplastic
Resin content	%	20
Specific weight	kg/m^3	60
Thickness	mm	10-12
Volatiles content	%	4.4
Resin flow	%	does not flow

PRODUCTION OF STRUCTURAL COMPOSITES

All the composites are fabricated by thermo compression in an open mold on a semi - industrial press in "Eurokompozit".

PRODUCTION OF STRUCTURAL COMPOSITES



The composite has been constructed by laying up a multiple number of prepreg plies, in accordance with the targeted thickness and cured at elevated temperature.

PRODUCTION OF STRUCTURAL COMPOSITES

Paper / phenolic resin - based prepreg

$T=130-140\ ^{O}C$

$Ps= 6 - 8$ MPa

Cotton / phenolic resin - based prepreg

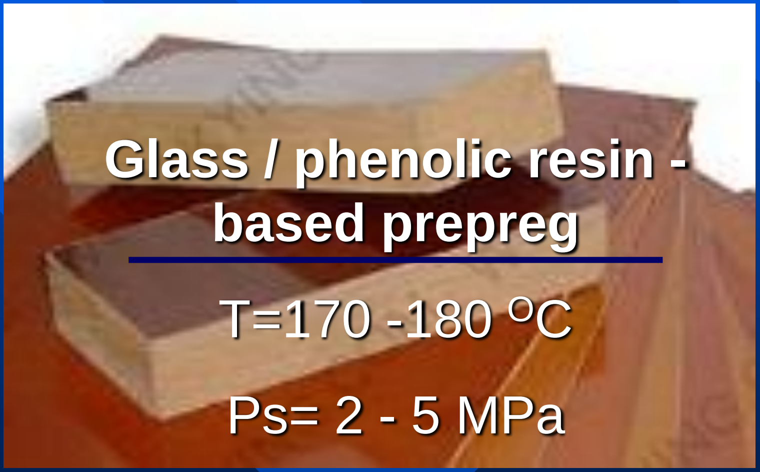
$T=130-140\ ^{O}C$

$Ps= 6 - 8$ MPa

Glass / epoxy resin - based prepreg

$T=170-180\ ^{O}C$

$Ps= 2 - 5$ MPa



Glass / phenolic resin - based prepreg

$T=170-180\ ^{O}C$

$Ps= 2 - 5$ MPa

$t = a + bx$

a,b-coef.

x-thickness of the composite

PRODUCTION OF KENAF FIBER COMPOSITES

The final composites we prepared of all available kenaf preforms.For comparison with the structural composites kenaf/biocomp composites were tested by the same methods.

The samples of the kenaf fibers preforms are prepeared of 7 layers of Isolkenaf (80% kenaf, 20% biocomp) under the following conditions:

Set: 7 layers kenaf / biocom

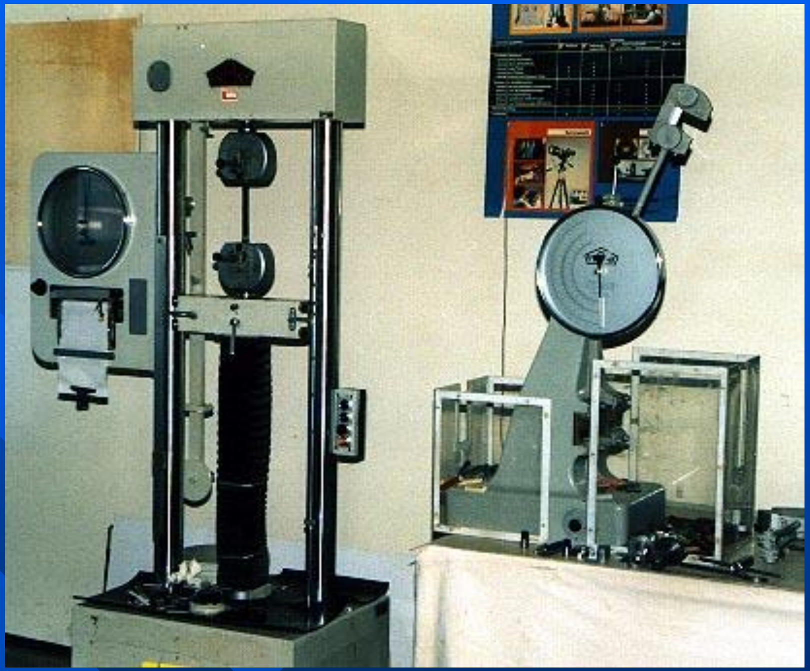
Press Cycle:
T=170°C
Ps = 185 bar
t = 15 min

The panels were fabricated also by thermocompression in an open mold.

The final composites were approxsimatly 5 mm thick and weighted approxsimatly 5,4 kg/m². The size of the composite plates is choisen for best utilization of the material since the test specimen have to be 120 mm long. Speciment dimensions were according to the respective standards.

TESTING OF COMPOSITES

For all mechanical tests:



Universal mechanical properties testing machine (Schenk and Frank, Germany) and Charpy impact tester

Basic physical and mechanical properties of some structural composites

Property	Test Method	Composite			
		Paper Phenolic	Cotton Phenolic	Glass Epoxy	Glass Phenolic
Specific weight, g/cm ^{3}	JUS G.S2.5 1	1,3 - 1,4	1,3 - 1,4	1,7 - 1,8	1,8 - 1,9
Water absorption, %	ISO/DP 9674	1,5-2,0	0,4-0,8	0,1-0,15	0,1-0,2

Basic physical and mechanical properties of some structural composites

Property	Test Method	Composite			
		Paper Phenolic	Cotton Phenolic	Glass Epoxy	Glass Phenolic
Flexural strength, MPa	DIN 53457	> 130	> 150	> 350	> 300
Flexural modulus, GPa	DIN 53457	7	7	18	14
Impact strength, an10, an15, kJ/m^2	DIN 53453	> 20	> 30	> 100	> 100

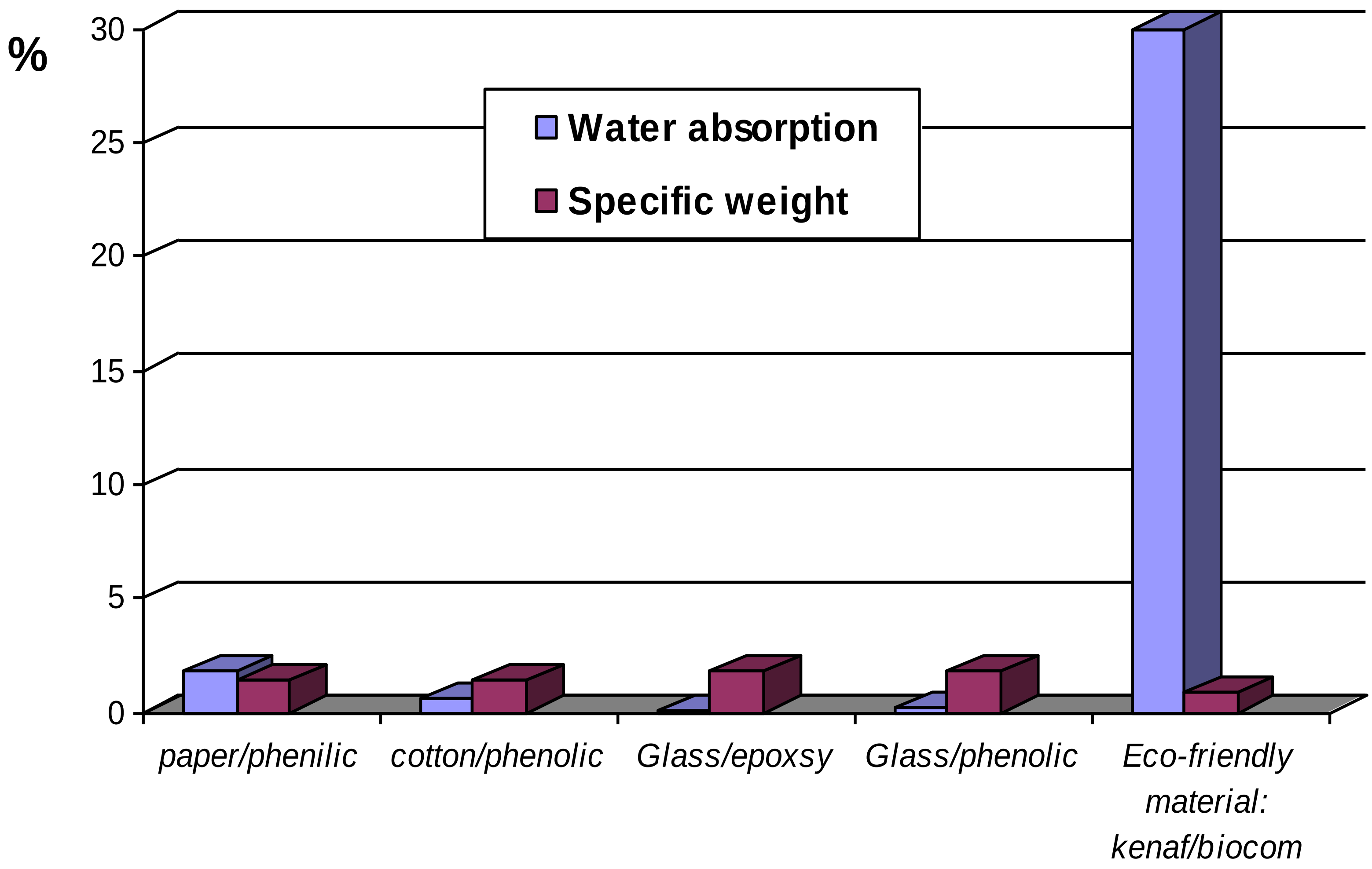
Basic physical and mechanical properties of some structural composites

Property	Test Method	Composite			
		Paper Phenolic	Cotton Phenolic	Glass Epoxy	Glass Phenolic
Tensile strength, MPa	DIN 53455	> 100	> 100	> 220	> 200
Compression strength parallel to the layers, MPa	DIN 53454	> 150	> 170	> 200	> 250

Basic physical and mechanical properties of kenaf/biocom composites

Property	Test Method	Composite: kenaf/biocom
Specific weight, g/cm^3	JUS G.S2.51	0,93
Water absorption, %	ISO/DP 9674	30,5
Fire resistance	UL 94	burns
Flexural strength, MPa	DIN 53457	30,1
Flexural modulus, GPa	DIN 53457	9,0
Impact strength, an5, kJ/m^2	DIN 53453	43,1
Impact strength, an10, kJ/m^2	DIN 53453	65,5
Compression strength, MPa	DIN 53454	17,4

WATER ABSORPTION AND SPECIFIC WEIGHT FOR ALL COMPOSITES

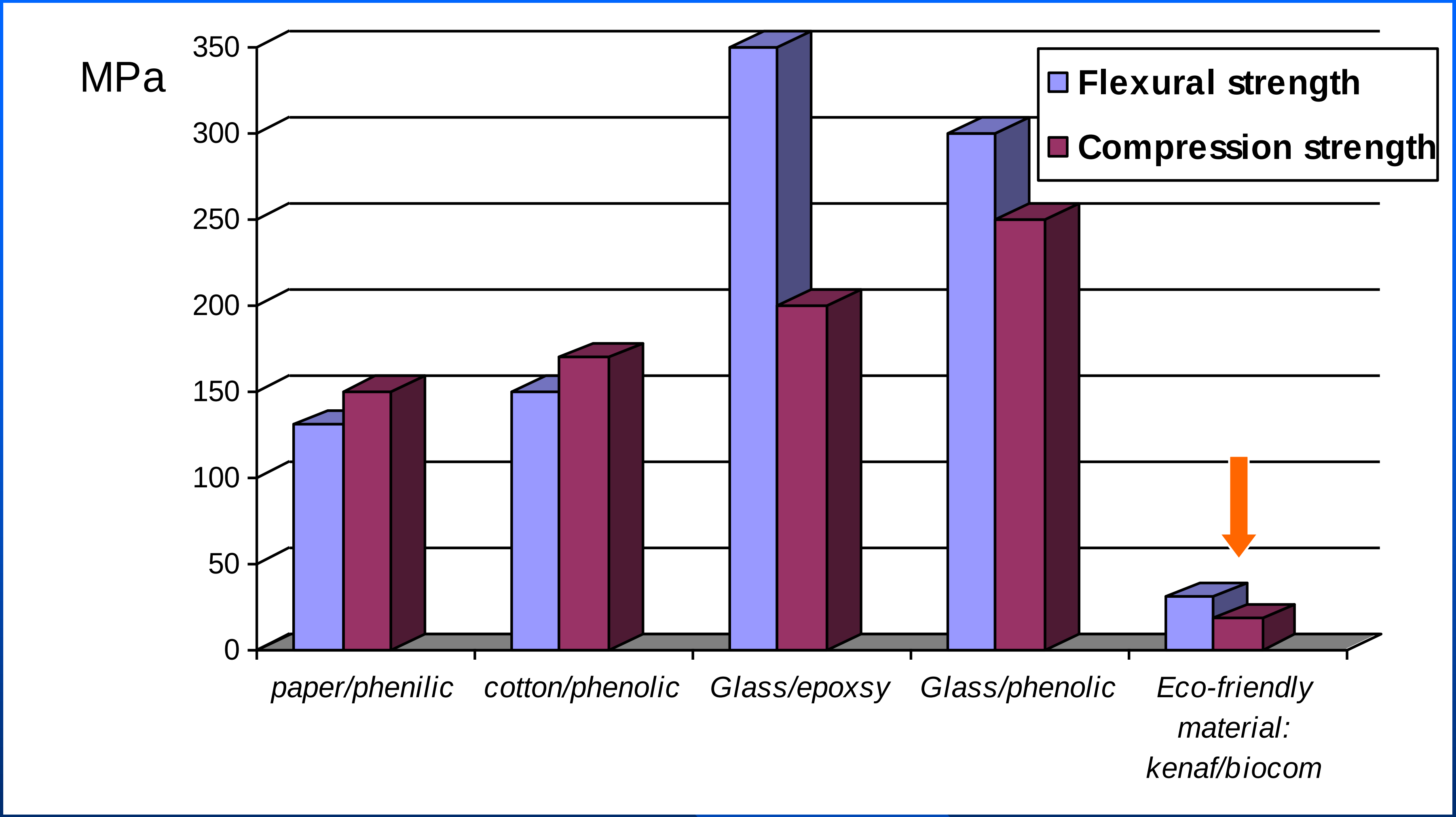


Water absorption and specific weight of kenaf fiber composites are important characteristics that determine end use applications of these materials. *Water absorption* could lead to a decrease in some of the properties and should be considered when selecting applications. Water absorption in kenaf fiber composites can lead to a build-up of moisture in the fiber cell wall and also in the fiber-matrix interphase region which would result in fiber swelling and affect the dimensional stability. Good wetting of the fiber by matrix and adequate fiber-matrix bonding can decrease the rate and amount of water absorbed in the interphasial region of composite.

A typical kenaf – biocom (80/20) composite has higher water absorption (30%) compared to structural composites. It is, therefore, very important to select applications where this high water absorption is not a critical property.

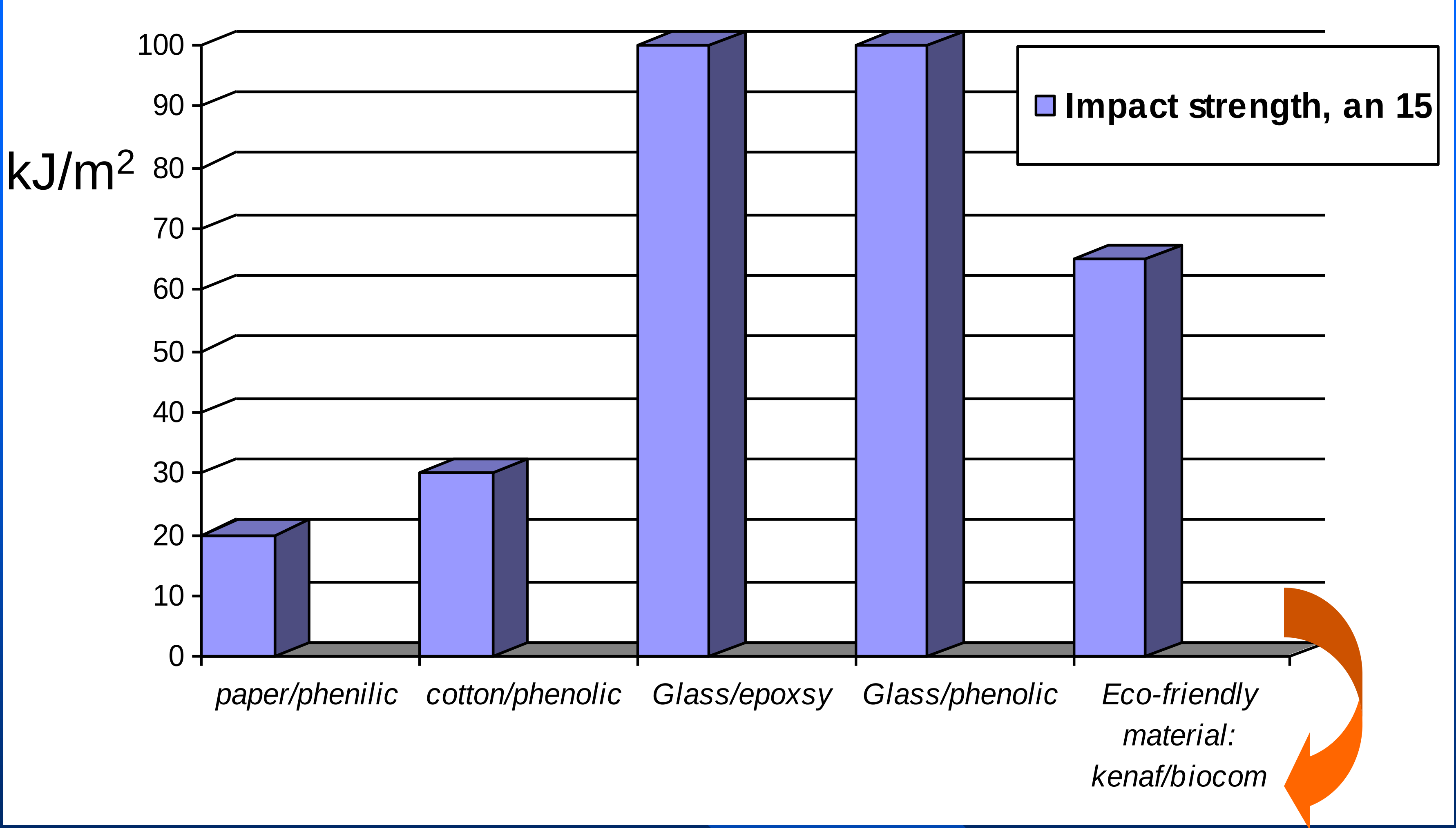
The *specific weight* of kenaf fibers - based composites is much lower than that of the structural composites. The specific gravity of the 80% (w/w) kenaf - biocom composite is about 0,9 g/cm^3 while that of a paper-phenolic is 1,3 - 1,4 g/cm^3 , a cotton-phenolic is 1,3 - 1,4 g/cm^3, a glass-epoxy is 1,7 - 1,9 g/cm^3 and a glass- phenolic is 1,8 - 1,9 g/cm^3.

FLEXURAL AND COMPRESSION STRENGTH FOR ALL COMPOSITES



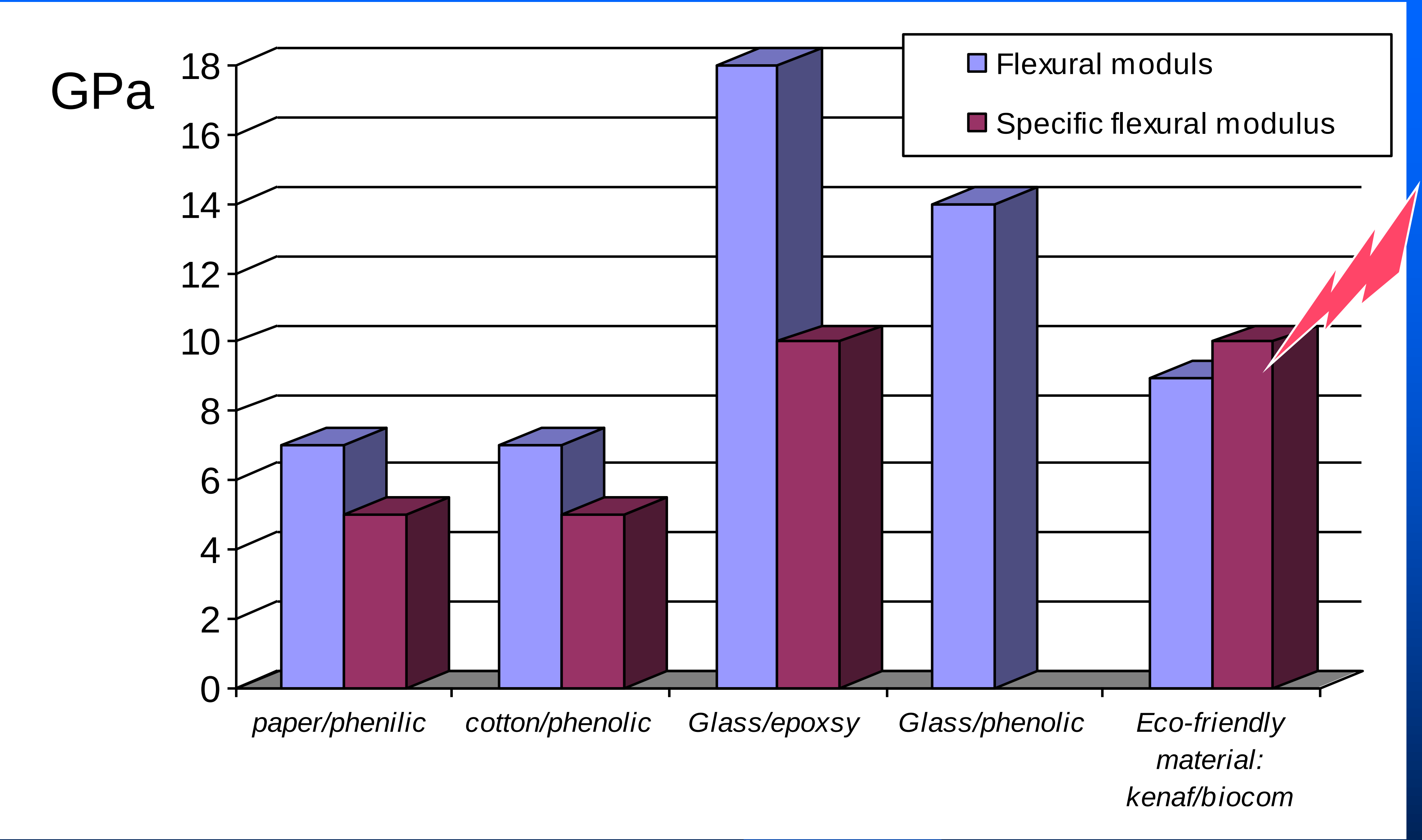
The figure sown a **flexural and compression strength** of the structural composites and kenaf fibers based composites. The compression strength and flexural strength of the kenaf-biocom composites (80/20) are lower than, reported values of the structural composites.

IMPACT STRENGTH FOR ALL COMPOSITES



The **impact strength** of the composite depends on the amount of fiber. The impact strength of a kenaf-biocom composites (80/20) is higher than that of the paper-phenolic and cotton-phenolic based composites but lower than that of the glass based composites.

FLEXURAL MODULUS FOR ALL COMPOSITES



The **flexural modulus** of the kenaf composites showed significant improvements. The specific flexural modulus of the kenaf-biocom composites (80/20) are nearly equivalent to, or higher than values of structural composites.

CONCLUSION

The primary advantages of using natural fibers as reinforcements in plastics are numerous. Such fibers may exhibit low densities, non abrasiveness, high specific properties (such as high filling levels possibly resulting in high stiffness properties),easily recycled nonbrittle fibers, sharp curvature allowances (with no fracture), and biodegradability. There may also be wide fiber availability (throughout the world).

One of the big areas of development is in combining natural fibers with thermoplastic.

Combining kenaf fiber with other materials provides a strategy for producing advanced composite materials that take advantage of the properties of both types of materials. It allows the researchers to design materials in accordance to the end - use requirements within a framework of cost, availability, recycliability, energy use, and environmental considerations. Kenaf fiber is a potentially outstanding reinforcing filler in thermoplastic composites.

The research has shown that high fiber/low matrix kenaf/biocom composites can fulfill the end user requirements for partitioning panels in buildings

11 ОКТОМВРИ
ЕУРОКОМПОЗИТ

THANK YOU FOR YOUR ATTENTION