POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture (Environment and Land)
Honors theses

The environmental sustainability of natural materials: LCA based studio of building insulation materials related to sources and production stage

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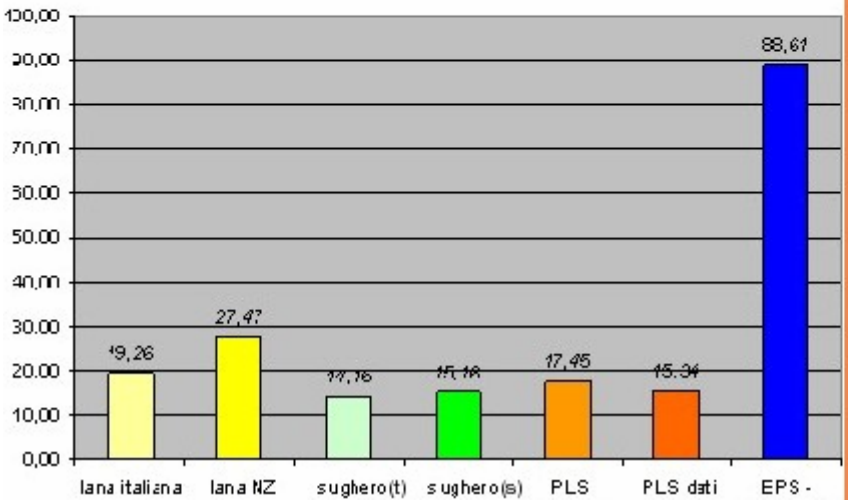
The construction sector is one of the most significant contributors towards pollution and the consumption of environmental resources. An environmentally focused approach to this project and its research allows for an anthropic evaluation that considers sustainable development. The objective of the thesis was to test the energetic and environmental appropriateness of using natural rather than artificial products. Seeing as there is a lack of detailed studies in this area a clarification regarding their environmental impact is necessary. The specific objective of the research is to study all aspects linked to the environmental impacts and consumption that takes place when using particular natural products, in collaboration with the Inter-university Centre for the Evaluation of Ecological Aspects in Construction, part of the DINSE.

The work analyzes natural products that are used for thermo-acoustic isolation according to the LCA method, *Life Cycle Assessment*, an analysis of the life cycle. Sheep's wool, cork and wood scrap can be utilized to produce animal wool, dark cork and mineralized wood fibre panel. Thanks to particular Italian companies that have supplied information regarding productive processes as well as data drawn from libraries, web sites and data banks, an inventory has been created on raw and combustible materials, products, transport and productive phases in order to reconstruct these productive processes. Once this data is inserted into data processing software, this can be used to calculate the consumption of energy, raw materials, other materials and, air, water and ground pollution in the various life cycle phases, using a standardized measuring unit [Kg] to allow for comparison. Emissions into the atmosphere have been linked to various ecological effects (climate change, etc); the final results gave indications to be used to improve systems or compare with other groups in the same field, for example L'EPS, Expanded Synthetic Polystyrene, the synthetic type. The LCA studies have been integrated in other studies, comparing the productive processes of various nations, hybrid forms of transportation, describing the various energetic aspects, ecological impact and the effects of animal farming in the Cuneo area. The total results of the analysis have been summarised using indicators such as CEP, CO_2 equivalent and other impacting aspects.

codici		lana IT	lana NZ-s	sughero-t	sughero-s	f.l.m. Bous.	f.l.m. Bonelli	EPS polistirene
GWP Boustead		1,179	0,762	-0,335	-0,230	0,624	0,455	3,289
Effetti amb.	u.d.m.							
GWP100	kg CO2	1,204	0,781	-0,316	-0,210	0,633	0,460	3,287
acidificazione	g SO2	16,912	17,157	2,553	4,009	15,599	11,553	13,637
photo-smog	g C2H4	2,425	1,837	0,313	0,820	4,678	3,352	4,926
eutrofizzazione	g NO3-	2,340	1,666	0,243	0,512	0,799	0,658	1,979
assott. f. ozono	g CFC11	1,70E-08	1,71E-08	6,46E-09	5,98E-08	4,90E-09	4,71E-09	2,56E-05



Risultati dell'analisi degli impatti

Consumo energia primaria PEI [MJ/Kg]

In accordance with recent energy regulations, the legal thermal transmittance of the four products studied was calculated within a typical atmosphere, in order to obtain the minimum thickness necessary to guarantee the values required by the regulations within the relative climate zone. After the dispersion of primary energy was evaluated, the production of CO_2 and the usage of raw materials relative to the surface unit were studied, in addition a market analysis of insulation prices was conducted.

Zone climatiche	A	B	C	D	E	F
limiti U W/m²K	0,62	0,48	0,40	0,36	0,34	0,33
spessori dell'isolante in cm						
lana	4,33	6,31	8,07	9,23	9,78	10,15
sughero bruno	4,13	6,01	7,69	8,79	9,31	9,66
f.l.m.	9,30	13,54	17,30	19,78	20,95	21,75
EPS	3,30	4,81	6,15	7,03	7,45	7,73

Calcolo degli spessori minimi per garantire le trasmittanze limite previste dalle norme in base alla zona climatica.

Prodotto	densità Kg/m³	spessore zona F - m	CEP MJ/kg	CEP MJ/m2
pannello in lana	20	0,102	19,26	39,10
pannello in sughero	120	0,097	14,15	164,03
pannello in f.l.m.	650	0,218	17,45	2466,99
EPS	20	0,077	88,61	136,99

Prodotto	densità Kg/m³	spessore zona F - m	U W/m²K	Kg/m²
lana	20	0,102	0,33	2,03
sughero	120	0,097	0,33	11,59
fibra di legno min.	650	0,218	0,33	141,38
EPS	20	0,077	0,33	1,55

Calcoli dei consumi energetici, delle materie prime e produzione di anidride carbonica, rispetto all'unità funzionale del mq.

Prodotto	densità Kg/m³	spessore zona F - m	GWP 100 CO_2/kg	Kg CO_2/m²
pannello in lana	20	0,102	1,179	2,39
pannello in sughero	120	0,097	-0,335	-3,88
pannello in f.l.m.	650	0,218	0,624	88,22
EPS	20	0,077	3,289	5,08

A final summery and commentary analyzes the core aspects of the thesis, regarding raw materials, workmanship, electrical consumption, emissions, waste, transport, health risks etc. . In the final results, sheep's wool resulted as the winner in many categories; favouring production and local industry for raw material while using little transportation that is non invasive, it is also predicted that the other natural products should have a main role within the eco-building sector.

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