

Noise pollution reduction based on recycled fiberglass from discarded wind turbine blades

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Abstract. *Noise is an increasing environmental issue in most urban areas, and more than 125 million Europeans are daily exposed to noise levels above the recommended maximum of 58 dB. Only surpassed by air pollution, WHO considers noise pollution to be the most critical European environmental issue and the market for noise reduction is conservatively estimated to have a value of 10 billion €. In this paper we present an innovative acoustic absorbent material manufactured from recycled wind turbine blades, one of its real applications and the perspective of future developments.*

1 The environmental issue of noise

Noise pollution has since antiquity tied up with human activity in cities. Senecas complained about noise in 1st century A.C. Rome [1], Leonardo da Vinci hated chariot wheels noise in 15th century Florence and even Schopenhauer wrote a brief text against noise in 1851 [2].

Ever increasing amounts of traffic via roads, railways and airports in addition to industrial activities continuously emit energy from subsonic up to ultrasonic bands. Humans are most sensitive in the range around 100-10k Hz, being the lower frequencies more keen in spreading around while higher being more directive.

Harmonised EU regulation [3] sets a threshold value of 58 dB for continuous exposure to external noise but due to the massive environmental impact WHO recommends the threshold value should be reduced to 53 dB.

Today, the most common noise reducing means comprise:

- Earthen ramparts – very effective but requires large areas along roads
- Noise barriers (shields) – very effective but rather expensive
- Noise reducing pavements – small contribution but must be renewed every 5-7 years
- Noise reducing tires – small contribution but yet in early stage
- Speed reduction – very effective but generally opposed
- Limiting of traffic – most effective but lack of sufficient alternative means of transport

2 Proposed material

The requirement for renewable energy sources has led to massive global investments in wind turbine farms. The typical construction of a wind turbine consist of a tower (up to 130 m) with an electric generator on the top driven by 3 rotating blades (up to 108 meter).

Most components of the turbines; tower, gear generator etc., are of metallic materials, all of which are routinely recycled when decommissioned. The rotating blades are, however, manufactured in composite materials for which no large scale recycling alternative is yet offered.

Miljøskærm® has independently developed a unique recycle path for composite materials comprising manufacture of a porous structure of fiber material by mechanical processing of the blades. The manufactured material has excellent properties for both acoustic and thermal insulation applications.

Compared to mainstream products our recycled fiberglass products offer:

- Documented equal or better acoustic performance
- Excellent thermal properties
- Not susceptible to compression by gravity
- May be tailored to specific acoustic performance / response
- Superior performance in humid and wet environments
- Inert to exposure to environmental conditions
- Substantial reduction of environmental impact by replacing virgin materials
- May be recycled several times

3 Case study

In 2016 Miljøskærm® were contracted by Copenhagen suburb Vallensbaek for the supply of a 85 meter long noise barrier to shield citizens from noise from a busy road through the community, a project partially funded by the Danish Environmental Agency [4].

The prototype product consisted of noise barrier elements manufactured with a supporting frame made of planks of recycled plastic containing the acoustic absorbent material of recycled fiberglass.

The products were tested for acoustic absorbing and damping properties by the accredited institute Delta and documented to meet the requirement of the recognised standard DS/EN 1793-1

In addition, on-site measurements of the achieved noise reduction at the housings were carried out 24/7 in 3 weeks before and 3 weeks after installation of our noise barrier. This documented that the noise level the citizens are exposed to was reduced from 61 dB to 54 dB thus reduced to below the recommended level of 58 dB.



Figure 1. Miljøskærm noise barrier installed in Copenhagen suburb Vallensbaek in 2016.

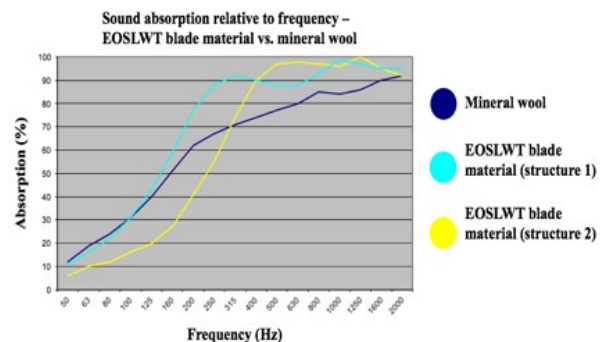


Figure 2. Measured acoustic absorption of our product vs mineral wool

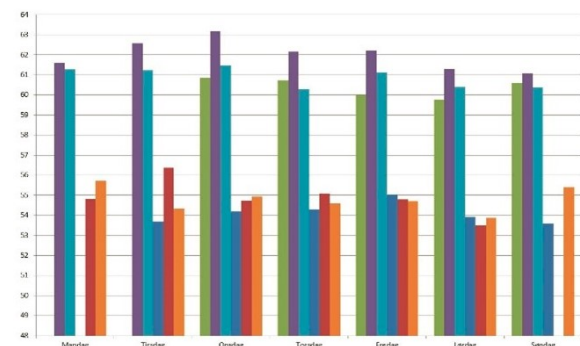


Figure 3. Continuous on-site noise measurement (dB) 3 weeks before and 3 weeks after installation of our noise barrier in Vallensbaek

4 Discussion

Our solution is addressing the two global environmental issues by:

- Reducing the impact of noise
- Reducing industrial waste by creating new value by recycling.

The noise barrier elements demonstrate:

- Creation of value by recycling problematic plastic and fiberglass waste to replace mainstream products

requiring much more energy and introduce recyclable insulation products (ref.: figures 4 & 5 [5])

- The technical properties are not compromised by replacing virgin materials with recycled materials (ref.: figures 2 & 3)

Manufacturing costs is on level with existing products and scaling up recycling and production capacity will further reduce the cost of the end products thus enhancing the road authority's incentive to support the circular economy by selecting sustainable products.

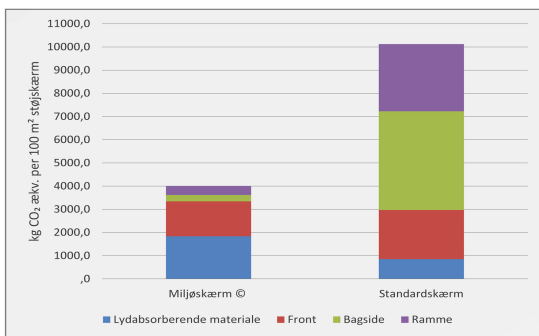


Figure 4. CO2 impact of manufacturing our Vallensbaek noise barrier vs manufacture of mainstream products of virgin materials.

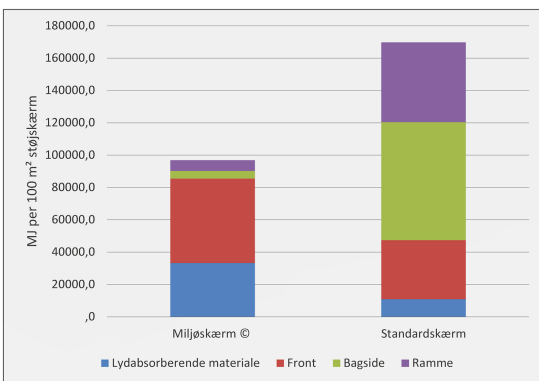


Figure 5. Energy consumption of manufacturing our Vallensbaek noise barrier vs manufacture of mainstream products of virgin materials.

5 Other potential applications

Recycling of composite materials is the core business of Miljøskærm® and we consider the acoustic insulation products intended for external noise barriers to be the first step towards substantial recycling of composite products such as wind turbine blades and

many other products from the building, transport and marine sectors.

Utilizing the excellent mechanical properties of the materials our ongoing research and product development work shows promising results towards introducing a unique thermal insulation product within 1-2 years. In addition to excellent thermal mechanical properties, our new product will add specific values (not yet to be disclosed) to existing products and address a very large commercial market demanding low-cost, robust and recyclable insulation products.

Further, we have identified an emerging market for many innovative applications of recycled fibers supporting the circular economy.

References

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- [2] Arthur Schopenhauer, Ueber Lerm und Geräusch, Parerga und Paralipomena, 2. Buch, Kapitel 30, Seite 517-519, A. W. Hayn, Berlin, 1851
- [3] EU directive 2002/49/EF Evaluation and limitation of external noise
- [4] Report no.: [978-87-93529-27-4.pdf \(mst.dk\)](#)
- [5] Environmental Screening report by COWI (2016)