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Environmental Impacts of the Recycling and Use of Waste Medium Density Fibre Board and the Benefits of Wood Fibre Recovery

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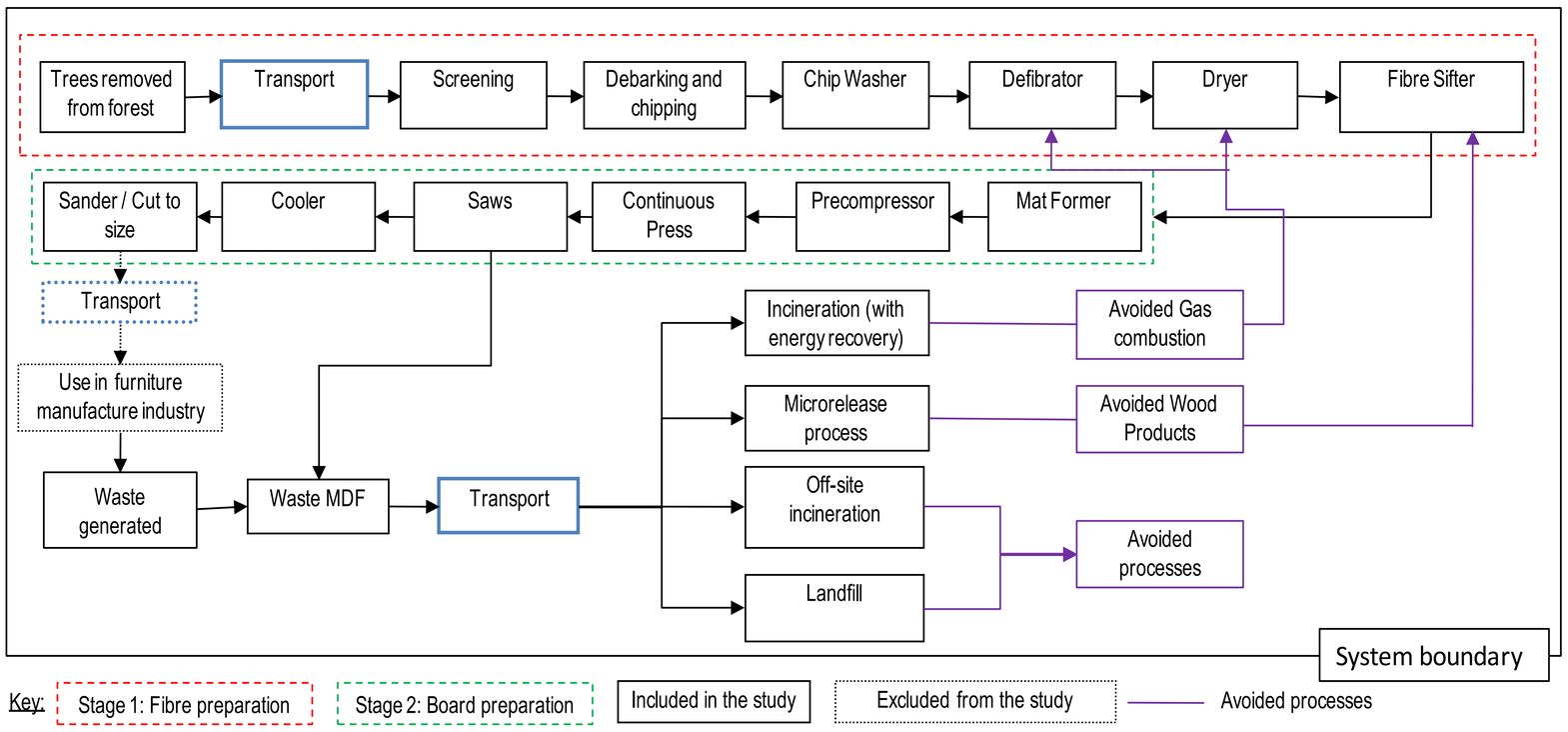
Introduction:

In the UK, as in Europe, there is a large demand for wood based panel board materials in many industries, such as construction and furniture manufacture. The annual production tonnage of these materials is significant, as is the amount of waste produced during firstly board and subsequently furniture manufacture. Current waste disposal routes include; incineration both with energy recovery and without and landfill, and each of these disposal practices has environmental impacts associated with them. There is an opportunity to avoid these impacts through diversion of MDF waste to material recovery and reuse. One such material recovery option relies on the use of Microwave technology to recover the wood fibres, and while these fibres could be used in a number of different applications (insulation, wood/polymer composites) the most elegant solution is closed loop recycling, back into MDF production.

The results of an environmental life cycle assessment study of the environmental performance of alternative waste management routes and the effects of diverting waste MDF to the Microwave fibre reclamation process are presented here. The study also examines the effects of using recovered wood fibres on the MDF production process, relative to the case where virgin fibres is exclusively used.



Goal and Scope:

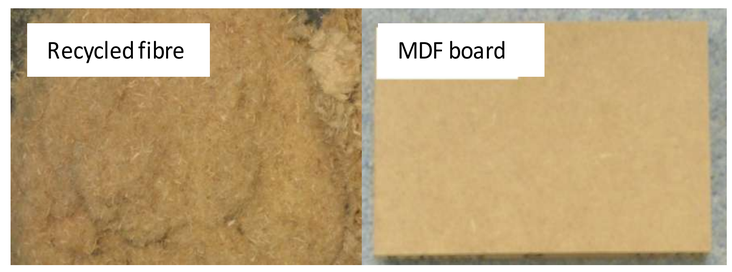
This study aimed at evaluating the environmental impacts of waste MDF in each of the primary waste management routes (See table) compared with recovery of fibres from MDF waste using Microwave recovery to supply recycled fibre to new MDF board production.

This work was done using SimaPro and was peer reviewed to conform to ISO standards.

Functional unit:

The functional unit chosen is 1tonne of MDF waste for disposal.

In order to effectively compare the environmental impact of use of the recycled fibre in production of MDF board, the study also uses a production unit of 1tonne of MDF board as compared with 1 tonne of recycled MDF (rMDF) to the same functional and visual specifications.

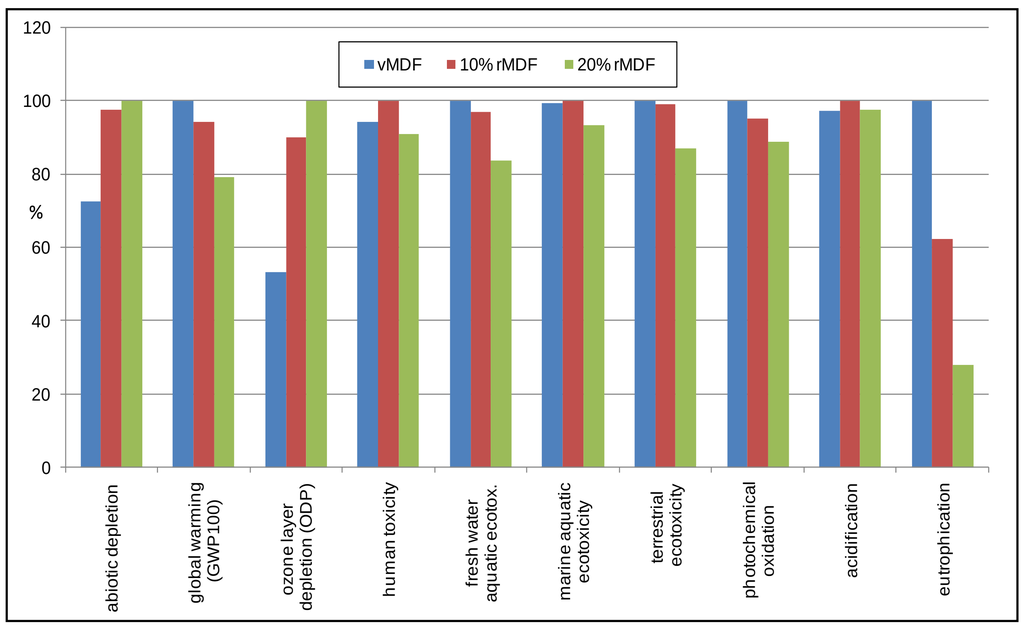


Impact Assessment:

The impacts of the **disposal of MDF waste** are shown in the table.

- Energy from waste, on-site, has the lowest environmental impact of all the disposal (i.e. with no material recovery) routes
  - All waste produced is used as a biogenic fuel source meaning an alternative fuel source (e.g. gas combustion) is avoided
- Microwave reclamation is shown as a standalone process producing recycled fibres and also, as an option including benefits accrued by not sending the MDF waste to current disposal options in addition to the avoidance of virgin fibre production
- There is a clear positive effect on the environmental impacts of the process through the avoidance of virgin fibre production and avoidance of landfilling a portion of the MDF waste
- If the MDF waste is not incinerated for energy production, then an alternative fuel will be combusted to make up the difference
  - This is an area where balance between incineration for energy and material recovery must be struck

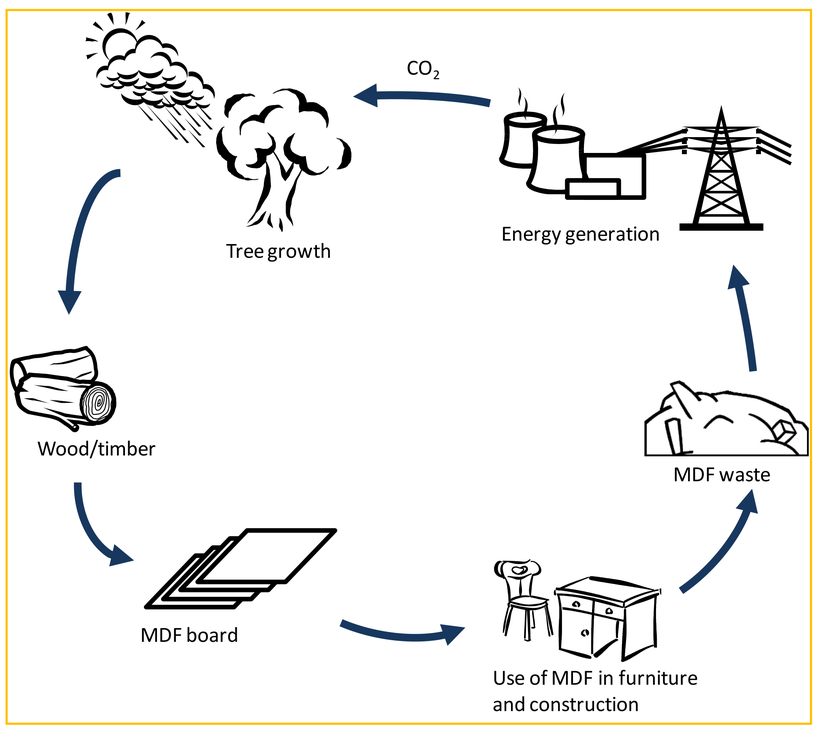
Impact Category	Unit	Disposal options for 1 tonne of MDF waste (100% scenarios)			Current disposal practice (72% Energy from waste onsite, 28% landfill)	Microwave fibre reclamation	
		Landfill	Energy from waste (onsite)	Energy from waste (offsite)		Without avoided processes	With avoided processes
Abiotic depletion	kg Sb eq.	0.25	-7.29	-7.21	-5.18	16.24	15.00
Global warming (GWP 100)	kg CO_2 eq.	81.92	-882.99	-871.36	-612.82	764.18	-1008.26
Ozone layer depletion (ODP)	kg CFC-11 eq.	3.64E-06	-1.15E-04	-1.13E-04	-8.09E-05	2.82E-04	3.01E-04
Human toxicity	kg 1,4-DB eq.	12.58	-111.17	-109.01	-76.52	267.17	78.70
Fresh water aquatic ecotox.	kg 1,4-DB eq.	11.05	0.50	0.95	3.46	25.35	-13.34
Marine aquatic ecotoxicity	kg 1,4-DB eq.	1.30E+04	-7.11E+04	-6.96E+04	-4.76E+04	3.15E+05	8.06E+04
Terrestrial ecotoxicity	kg 1,4-DB eq.	0.36	-0.87	-0.85	-0.53	2.05	-0.56
Photochemical oxidation	kg C_2H_4 eq.	0.02	-0.10	-0.09	-0.06	0.24	0.10
Acidification	kg SO_2 eq.	0.16	-0.68	-0.62	-0.44	4.10	2.08
Eutrophication	kg PO_4 eq.	2.63	0.20	0.22	0.88	0.39	-0.82



vMDF *vs.* rMDF:

A comparison of the impacts of the **production of vMDF (virgin fibre) and rMDF (containing a recycled fraction)** is shown in the figure. The results show:

- There is a mixed picture as the amount of recycled fibre in MDF board production is increased.
- There is clearly a reduction in many environmental impacts with increase in recycled fibre content when taking into account displacement of 1 tonne of virgin fibre
- The 20% recycled content does not result in a 50% reduction in the environmental impacts over the 10% rMDF case
- Increasing the recycled fibre content results in the MDF waste not being available for incineration with energy recovery
  - Alternate sources of energy (gas combustion) must be used
- For some of the impact categories a balance is struck between the harmful impacts of the gas combustion required and the avoidance of the energy used in virgin fibre production due to the use of recycled fibres



Conclusions

- Diversion of MDF waste to Microwave fibre reclamation has a smaller environmental impact than the majority of other disposal methods
- Energy from waste allows avoidance of other methods of heat generation and so also shows low environmental impact
- Up to 0.52 tonnes of CO_2 equivalent may be saved for each tonne of finished MDF board produced containing 20% recycled fibre

Points raised for further investigation during this study:

- What is a good balance between waste MDF fate between incineration for energy recovery and recycled fibre production?
  - Sensitivity analyses suggest that there is a benefit to dividing MDF waste between the two to create benefit both from avoiding virgin wood fibre production, and gas combustion to fuel MDF production

Issue of assumptions regarding the wood coming from a Sustainable Forest

- Can biogenic CO2 be totally removed from impact calculations?
  - MDF is a relatively young technology in comparison with the growth pattern of new trees, is it reasonable to assume that a growing tree absorbs all of the biogenic CO2 emitted in energy recovery from MDF as the fuel is designated as biogenic in the EU and UK, but when used in MDF recovery no biogenic carbon credits are allocated ?

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For further information on this work please see the published report ISBN: 1-84405-417-9 (http://www.wrap.org.uk/recycling_industry/publications/life_cycle_of_mdf.html)

From any further information please feel free to contact: Enquires, Gnosys UK, University of Surrey, Guildford, GU2 7XH, UK, +44 (0)1483 689599, http://www.gnosysuk.com/

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