COMPARATIVE LIFE CYCLE ASSESSMENT OF

WOOD AND COMPOSITE PALLETS

EXECUTIVE SUMMARY

In order to better understand, quantify, and address strengths and improvement opportunities of RM2's BLOCKPal composite shipping pallets in terms of their potential environmental impacts, and to be able to communicate to our customers and other interested parties how our BLOCKPal's potential environmental impacts compare with those of the typical wood block pallet, RM2 commissioned an independent, critically-reviewed comparative life cycle assessment (LCA) study of the two product types.

LCA is a science-based method for systematically assessing the inputs (i.e., materials and energy), outputs (i.e., wastes and emissions), and potential environmental impacts of products and or processes. This study was performed in compliance with the ISO 14040/14044 standards for LCAs that are intended to be used to support public comparative assertions, including undergoing 3rd-party critical review by a panel of experienced LCA practitioners.

Both pallet types in this study are used in a re-use system, in which the pallet manufacturer retains ownership of the pallets and tracks their usage as they are shipped from one customer to another when the usage at the prior customer is complete. The scope of this study is a cradle-to-grave assessment of the RM2 composite pallet and a typical wood block pallet used in this type of re-use system, including materials and component production and transport, pallet manufacturing, distribution, usage, repair, and end-of-life disposition. A small amount of pallets are lost during normal usage, and these losses are also modeled for each pallet.

In order to make a consistent comparison of these pallets, which have different weights, durability, loss rates, and other performance characteristics, a functional unit of 100,000 pallet trips was used for the comparison. This is consistent with the functional unit used in other published LCA studies of shipping pallets. The reference flow, or the number of pallets required to meet the 100,000-trip performance, is 899 for the RM2 pallet and 4,400 for the wood pallet. The RM2 pallet is more durable and has a lower loss rate that the wood pallet, which accounts for the lower number of pallets required.

Assessments of potential impacts were performed using the CML (Center for Environmental Science at the University of Leiden) impact assessment methodology, one of the most widely-accepted and widely-used LCA impact assessment methodologies. Impact categories and indicators assessed include:

- Acidification potential (AP; kg SO4 equivalent)
- Eutrophication potential (EP; kg phosphorous equivalent)
- Global warming potential (GWP; kg CO2 equivalent)
- Ozone depletion potential (ODP; kg CFC-11 equivalent)
- Photochemical ozone creation potential (POCP; kg ethene equivalent)
- Primary energy demand – total (PED tot; Megajoules)
- Primary energy demand – non-renewable (PED nr; Megajoules)

The LCA study modeling and calculations were performed using GaBi 6 Professional LCA software.

The LCA models of the two products were created using primary data where possible, such as material composition and mass of the RM2 pallet, manufacturing energy requirements for the RM2 pallet, etc.

Secondary data was used for the mass, composition, manufacturing, usage, and disposal of wood block pallets. Secondary information on wood block pallets was obtained from published LCA studies of wood block pallets. The materials, component transport distances, and manufacturing processes, and end-of-life disposition for each pallet were modeled to be as closely representative of each pallet as possible. Transportation distances for the distribution of the pallet to the first user, the distance between users, and to landfill at end of life were assumed in the baseline scenario to be the same for both pallet types. Sensitivity and scenario analysis was performed to understand the impacts of changing various parameters and/or assumptions.

Table 1 shows the life cycle impact results across the studied impact categories for the RM2 pallet and the wood block pallet, as well as the percent difference for the RM2 pallet compared to the wood pallet.

TABLE 1: OVERALL RESULTS BY IMPACT CATEGORY FOR RM2 AND WOOD PALLETS

	AP Kg SO_2 eq	EP Kg Phos eq	GWP Kg CO_2 eq	ODP Kg R11 eq	POCP Kg Ethene eq	PED tot MJ	PED nr MJ
RM2	1,101	212	238,608	.00785	(187)	4,007,570	3,872,670
Wood	1,592	380	302,978	.00361	(196)	7,984,086	4,319,587
RM2 % Difference vs. Wood	-31%	-44%	-21%	+117%	+5%	-50%	-10%

The results indicate that, based on the data and assumptions of this LCA model, the RM2 pallet has:

- Lower impact than a wood block pallet for:
  - Acidification potential (AP; RM2 31% lower than wood)
  - Eutrophication potential (EP; RM2 44% lower than wood)
  - Global Warming potential (GWP; RM2 21% lower than wood)
  - Primary energy demand – total (PED tot; RM2 50% lower than wood)
  - Primary energy demand – non-renewable (PED nr; RM2 10% lower than wood)

- Similar impacts to a wood block pallet for:
  - Photochemical Ozone Creation Potential (POCP; RM2 5% higher than wood)

- Higher impact than a wood block pallet for:
  - Ozone depletion potential (ODP; 117% higher than wood (ODP impact for both products was driven in large part by the release of CFC-114 refrigerant during nuclear power generation).

For all impact categories except POCP, the loaded use phase (i.e., transporting the pallet during use) accounts for the highest percentage of total impacts. Material production also accounts for a significant percentage of total impacts, and is the highest-impact phase for POCP. The sensitivity analysis identified pallet weight as a key driver of overall life cycle potential impact because it is a factor that drives impacts across the life of the pallet including the use and material production phases. Additional interpretations and assessments of various scenarios are provided in the full report.

Based on the study results, there are several actions RM2 could take to further reduce the environmental impact of its composite pallets:

- Continue to seek opportunities to reduce pallet weight while maintaining or increasing pallet durability and performance.
- Minimize the transport distance between pallet users via diligent customer targeting and logistics planning and support.
- Maintain or reduce the already very low pallet loss rate, which is due to RM2's pallet tracking system.

Study commissioner:	RM2 International (RM2)
Study performed by:	Pure Strategies, Inc. 47R Englewood Road Gloucester, MA 19030

LCA study performed and LCA report produced in accordance with ISO 14040 and 14044 standards.