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Report

CRADLE-TO-GATE CARBON FOOTPRINT ANALYSIS FOR MASKING TAPE

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Prepared for:

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Executive Summary

Incorporated in 2011, GTG Manufacturing Sdn. Bhd. (GTG Manufacturing) is one of the leading manufacturing and supplier of adhesive tapes and stretch films in Malaysia. They strive to offer high quality products marketed worldwide such as in Americas, Africa, Asia, the Caribbean, Europe, the Ocean, and Middle East at competitive prices. The company is interested in assessing carbon emissions associated with its wide range of product as a key step towards a more cohesive environmental sustainability initiative.

GTG Manufacturing Sdn. Bhd has identified one of their products known as ***Masking Tape*** to undergo carbon emissions assessment related to the use of materials and energy consumption as well as transportation during the production process. The ***Masking Tape*** is a variety of adhesive tape that is recommended for the temporary concealment of surfaces not intended for a finishing process. It temporarily protects the areas from painting, soldering, blasting, spraying, coating, plating, and polishing while these procedures are administered to nearby surfaces. The scope of the study is from cradle-to-gate and the production inventory data is collected and provided by GTC Manufacturing.

The assessment aims to support GTG Manufacturing's initial exercise in product's environmental performance evaluation. The results will be used for future planning, strategy, and environmental sustainability initiatives in GTG Manufacturing's business activities.

This report is representing the carbon footprint (CFP) analysis of ***Masking Tape***, based on GTG Manufacturing facility in Semenyih. The result of the assessment shows that the CFP value is 10.20 $kgCO_2e/kg$ of masking tape from cradle-to-gate.

1. Introduction

GTG Manufacturing Sdn. Bhd. (GTG Manufacturing) was established on 15 November 2011 with the aim of supplying superior quality adhesive tape to their customers at competitive prices. Among the various types of self-adhesive tape that they provide to their customers in the form of jumbo rolls, log rolls or finished rolls include single sided tape such as OPP Packing Tape, Masking Tape, PVC Black Protection Tape, PVC Floor Marking Tape, PVC Insulation Tape, PE Protective Film, Cloth Duct Tape, Aluminium Foil Tape, Filament Tape, Teflon Tape, and others. They also supply double sided tape, acrylic foam tape, and protective film for application on various surfaces such as electronic device, injection moulding, automotive, construction glass, carpet, aluminium profiles, ceramic tiles etc.

This report is representing the CFP analysis of product namely ***Masking Tape*****,** which featured as premium grade crepe paper masking coated with natural rubber adhesive.

SIRIM has been approached by GTG Manufacturing to conduct Carbon Footprint (CFP) analysis for their product namely ***Masking Tape.*** The ***Masking Tape*** featured as a premium grade crepe paper masking coated with natural rubber adhesive. The CFP assessment for ***Masking Tape*** has been conducted based on lifecycle inventory data from GTG Manufacturing's product manufactured in Semenyih, Selangor. The details information of the manufacturing plant is provided herewith. The details information of the manufacturing plant is provided herewith.

Name of company and address	:	GTG MANUFACTURING SDN. BHD. NO 1, JALAN PLUMBUM 1/1, KAWASAN PERINDUSTRIAN SUNGAI PURUN, 43500 SEMENYIH, SELANGOR, MALAYSIA
Production site and address	:	Same as above
Name of contact person	:	Mr. Steve Ong
Contact no	:	+603-8725 9988, +6012-3246 908
Regulatory requirements for the operation	:	Environmental Quality Act 1974 Environmental Quality (Scheduled Wastes) Regulations 2005 Occupational Safety and Health Act (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000
Information on environmental management system	:	ISO 9001:2015 (Quality Management Systems) ISO 14001: 2015 (Environmental Management Systems)

2. General Description of Quantification Methodology

The carbon emissions quantification in this assessment adopts the general principle for product carbon foot-printing approach although it did not cover the complete life cycle phases. This assessment is tailored to the intention of GTG Manufacturing Sdn. Bhd in focusing on the effect of different types of material used in product components to carbon emissions value.

ISO I4044: Life Cycle Assessment (LCA) as the over-arching principle to evaluate the environmental burdens associated with a product, process or activity which includes the identification of energy, raw materials and substances used, emissions and wastes released to the environment over its life cycle. Riding on the principles of LCA, carbon foot-printing is introduced as method to assess single environmental impact category over a product's life cycle stages associating with raw materials used, design, production, transportation, use and its end-of-life (ISO 14067: 2018). Carbon-equivalent emission comprises of greenhouse gases (GHGs) emissions. The GHGs, mainly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are accounted to derive the carbon equivalent emission factors using 100-year GWP coefficients, IPCC Fourth Assessment Report: Climate Change 2007.

The carbon quantification considers the first two phases of the LCA concept, i.e., goal and scope definition and life cycle inventory (LCI) analysis and excludes the life cycle impact assessment (LCIA) and results interpretation phases. The quantification coverage is specified through a system boundary from where the assessment indicates whether it is a segmented quantification, a partial-life cycle, or a complete life cycle quantification. This assessment is a segmented carbon emissions measurement based on the system boundary set to meet the intended goal of the assessment. Within the set boundary, there are two (2) different sources of data required, primary data and secondary data. In principle, primary data shall be collected as site specific data or foreground data. Whereas secondary data are data gathered from published sources (LCI databases, LCA journals, web-publication, etc) for related environmental emissions coefficients (emission characterisation factors) as well as measures to fill data gaps in primary data. The quantified carbon value also depends on the availability of the LCI datasets and options available to choose from. Any data gaps, limitations and assumption are reported as quantification barriers.

3. Goal and Scope of Study

3.1. Goal

The goal of this assessment is to quantify the carbon emissions associated with ***Masking Tape*** manufactured by GTG Manufacturing Sdn. Bhd. at their manufacturing facility located at No. 1 Jalan Plumbum 1/1, Kawasan Perindustrian Sungai Purun, 43500 Semenyih, Selangor. The assessment aims to support GTG Manufacturing's initial exercise in product's environmental performance evaluation. The

results will be used for future planning, strategy, and environmental sustainability initiatives in GTG Manufacturing's business activities.

3.2. Scope

The scope of this assessment is determined from cradle-to-gate.

Details of the assessment's scope are described further in each section below.

3.3. Function of the Product

The product functions as general-purpose adhesions to metal, rubber, plastic, and fibreglass.

3.4. Functional Unit

The functional unit is defined as $kgCO_2e$ per kg of ***Masking Tape*** produced.

3.5. Product System Assessed

The product assessed in this CFP study is ***Masking Tape***, which featured as premium grade crepe paper masking coated with natural rubber adhesive. Brief product information is provided below.

Figure 1: Photo of Masking Tape

The technical specifications of the product are shown in Table 1.

Table 1: Specifications of Masking Tape

Product Code	GP
Length (L)	18m
Horizontal width (W)	48mm
Material type	Crepe paper backing/ rubber adhesive
Weight (wt.)	100g
Cut Sizes	As per customer requirement

3.6. Process Map and System boundary for Quantification

The main unit process in the production of **Masking Tape** is shown in Figure 2 below.

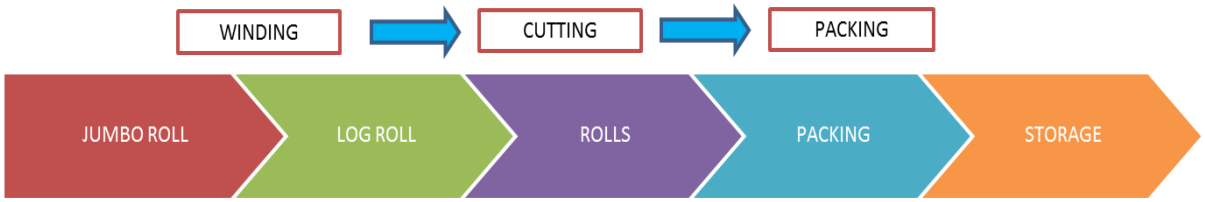

Figure 2: Process Flow to Produce Masking Tape.

The description of the three (3) main unit processes are stated below:

i. Winding process
The bulk jumbo rolls are winded to form log rolls.

ii. Cutting process
The log rolls are cut into specific sizes of rolls as per customer requirement.

iii. Packing process
The specific sized products are wrapped and packed into cartons to be stored in the warehouse.

The process map together with its system boundary for the life cycle of **masking tape** is illustrated in Figure 3 below. Since the scope of the study is from cradle-to-gate, only raw material extraction phase and product manufacturing phase were involved in the CFP study. Whereas, use phase and end-of-life phase were excluded in this study.

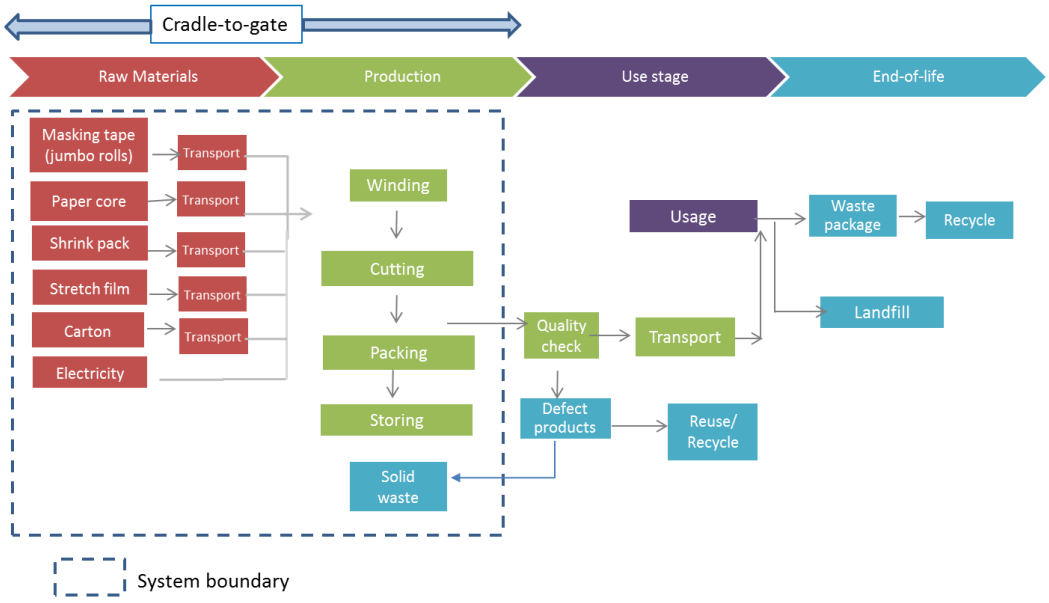

Figure 3: Process Map together with its System Boundary to Produce Masking Tape

3.7. Allocation Procedures

The allocation approach is not applied in this assessment because the production process produces only single product which is masking tape.

3.8. Data Requirement and Data Quality

Primary /Foreground Data: Site data as primary data source relevant to the products, appropriately collected and compiled by data owner. Site data are actual data obtained from various data owner in the product's life cycle phases. In cases where actual measured data are not available or too complex for collection, substitutes data through theoretical calculation and estimates are acceptable with consideration on their level of accuracy. Details on the site-specific data are further incorporated in the section onwards.

Secondary / Background Data: Secondary data are data information of characterisation factors (carbon emission factors, EFs) as well as product related data deemed appropriate for filling in any possible data gaps found in primary data. For the characterization factors, the data information normally is sourced from the following:

- Malaysia Life Cycle Inventory Database (MYLCID)
- Commercial databases (GaBi, EcoInvent, etc.)
- Published journals and articles

Available EFs used in the carbon quantification are tabulated herein. Wherever there are no EFs listed for data items, it is understood that no carbon emissions being accounted for in association with the

respective data items. This data gap(s) therefore would affect the quantified results; i.e. reduced carbon value due to data gaps. This data gap situation is further addressed under the 'Limitations and Assumptions' section.

Table 2: Summary of Carbon Emission Factors and Sources.

Data Item	*Material Type*	*Emission Factor (EF)*			
		**Value*	*unit*	*EF Source*	*EF Description*
Masking tape	Crepe paper backing	0.0259	$kgCO_2e/kg$	GABI/ SIRIM KK	(CH)-paper
	Rubber adhesive	2.6442	$kgCO_2e/kg$	Ecoinvent/SIRIM KK	Synthetic rubber, at plant
Paper core	Core board	0.4850	$kgCO_2e/kg$	Ecoinvent/ SIRIM KK	Core board, at plant
Carton	Corrugated paper	1.3832	$kgCO_2e/kg$	MYLCID	Corrugated board (technology mix | production mix, at factory | 18% primary fibre, 82% recyclyed fibre)
Stretch film	Packaging film	2.6905	$kgCO_2e/kg$	Ecoinvent/SIRIM KK	Packaging film, LDPE, at plant
Shrink pack (PVC shrink film)	Packaging film	2.384	$kgCO_2e/kg$	Ecoinvent/SIRIMKK	GABI-Polyvinylchloride granulate mix (S-PVC)
Electricity	Electricity	0.89	$kgCO_2e/kWh$	MYLCID	Electricity grid mix (Peninsular Malaysia)
Diesel (production)	Fuel	0.3711	$kgCO_2e/kg$	MYLCID	Diesel (from crude oil | consumption mix, at refinery | 500 ppm sulphur)
Diesel (combustion)	Fuel	3.1863	$kgCO_2e/kg$	IPCC	Gas/ diesel oil
Lorry (3 tonne)	Transportation	0.4833	$kgCO_2e/t.km$	Ecoinvent/SIRIM KK	Lorry 3.5-7.5t EURO 3/RER
Lorry (20 tonne)	Transportation	0.18450	$kgCO_{2e}/t.km$	Ecoinvent/SIRIM KK	Lorry 16-32t EURO 3/RER
Ship	Transportation	0.01068	$kgCO_2/tkm$	Ecoinvent/SIRIM KK	Transoceanic freight ship/OCE

3.9. Limitations and Assumptions

It is inevitable that some limitations and assumptions need to be made to address data gaps or irregularities (involving both primary and secondary data) to close the quantification process. Listed below are the limitations and assumption observed in the assessment.

Limitations:

- Input data for jumbo role masking tape components i.e., crepe paper backing, and rubber adhesive was calculated based on its MSDS.
- There is limited emission factor for crepe paper backing, hence emission factor for paper was considered in the calculations.
- The carbon emissions from the manufacturing of jumbo role masking tape at the supplier's factory was not considered in the calculation due to the difficulty of obtaining the inventory data of the process.

Assumptions:

- Mode of marine transport were assumed as transoceanic freight ship/OCE for the marine transportations of jumbo rolls from China, Singapore, and India to Port Klang.
- Port of departure in China, Singapore and India were assumed as Port of China (Shanghai), Port of Singapore (Pasir Panjang) and Port of India (Mumbai) for the marine transportations of jumbo rolls to Port Klang. Port distances were measured in nautical miles (nm), whereby 1nm equals to 1.852km.
- Carton (paper) sourcing location was in Semenyih, same location as the factory, distance for transportation was accounted as 10km.
- Density of diesel was assumed at 0.832kg/L for the conversion of diesel from L to kg.

4. Life Cycle Inventory Analysis

The site-specific inventory data for quantification purposes are provided in this section.

The summary of input-output data for production of **Masking Tape** by GTG Manufacturing plant is shown in Table 3.

Table 3: Input-Output Data for the Production of Masking Tape

Input		
Process 1: Winding		
Material	*Quantity*	*Unit*
Masking tape (Jumbo roll)	29098	kg
Paper core	760	kg
Electricity	3846	kWh
Process 2: Cutting		
Material	*Quantity*	*Unit*
Electricity	3846	kWh

Process 3: Packing		
Material	*Quantity*	*Unit*
Electricity	8333	kWh
Carton	6426	kg
Shrink pack	96	kg
Stretch film	536	kg
Diesel (production)	662	kg
Diesel (combustion)	662	kg
Output		
Product		
Material	*Quantity*	*Unit*
Masking tape	96264	kg
Solid Waste		
Material	*Quantity*	*Unit*
Plastic waste	287	kg
Paper waste	138	kg

Information on the transportation of production materials and solid wastes from the source location to the transit site/ factory site/ disposal site are shown in Table 4.

Table 4: Transportation of Production Materials and Solid Waste

Material	*Source location*	*Transport mode*	*Transit site/factory site/ disposal location*
Paper core	Sg Buloh	20 tonne lorry	Factory site
Masking tape (Jumbo roll) * *Ratio from sourcing location: China (80%) Singapore (10%) India (10%)*	Port of China (Shanghai) to Port Klang	Marine transport mode, Transoceanic freight ship/OCE	Port Klang
	Port of India (Mumbai) to Port Klang	Marine transport mode, Transoceanic freight ship/OCE	Port Klang
	Port of Singapore (Pasir Panjang) to Port Klang	Marine transport mode, Transoceanic freight ship/OCE	Port Klang
	Port Klang	30 tonne lorry	Factory site
Carton	Kajang	30 tonne lorry	Factory site
Diesel	Semenyih	3 tonne lorry	Factory site

Shrink pack	Port of China (Shanghai) to Port Klang	Marine transport mode, Transoceanic freight ship/OCE	Port Klang
	Port Klang	30 tonne lorry	Factory site
Stretch Film	Batu Pahat	30 tonne lorry	Factory site
Plastic waste	Factory site	26 tonne lorry	Disposal site
Paper waste	Factory	26 tonne lorry	Disposal site

5. Results and Discussions

The carbon emission profiles for CFP analysis of the **masking tape** are tabulated in Table 5 and Figure 4 below.

Table 5: Profiles of CO_2 Emissions for the Production of Masking Tape.

Processes	*Carbon Emissions*			*(%)*
	$kgCO_2e$/carton	*$kgCO_2e$/unit*	*$kgCO_2e$/kg*	
Winding process	71.652	0.995	9.95	97.58
Cutting process	0.256	0.004	0.036	0.35
Packing process	1.524	0.021	0.212	2.08
Total carbon emissions ($kgCO_2e$)	73.432	1.020	10.20	100

*Note: All processes have accounted the transportation data.

Based on the results in Table 5, it can be seen that most of the carbon emission was emitted from the winding process, contributing to 97.58% of the total emissions. The packing process and the cutting process contributed to 2.08% and 0.35% respectively. With respect to the solid waste generation, this process contributed to negligible carbon emissions. The total carbon emissions were 73.432 $kgCO_2e$/carton or 1.020 $kgCO_2e$/unit or 10.20 $kgCO_2e$/kg of ***Masking tape*** respectively.

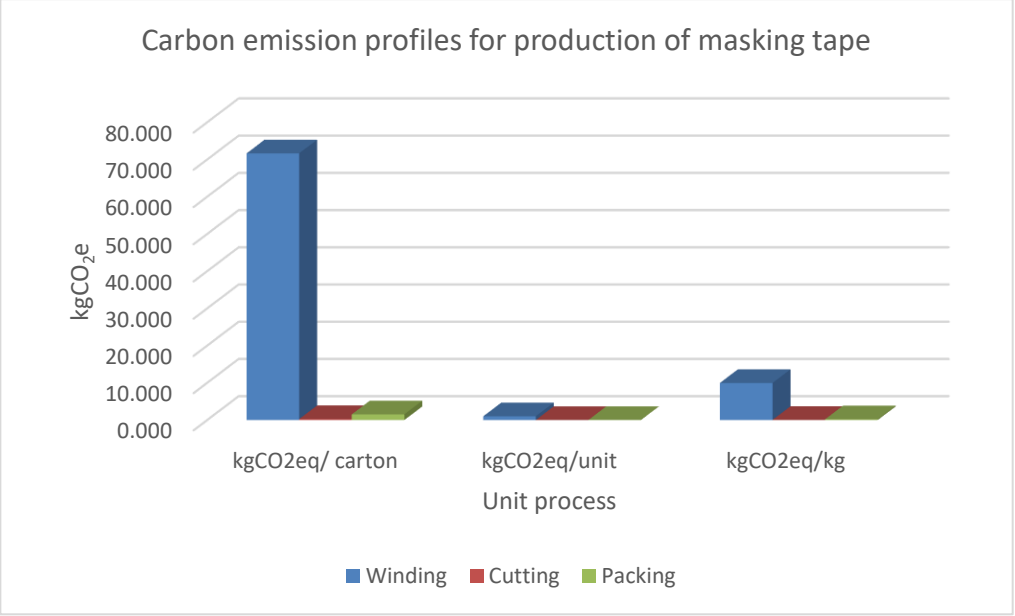

Figure 4: Breakdown of Total Carbon Emissions for Production of Masking Tape

Figure 4 showed that the carbon emissions from the winding processes contributed the highest emission (hotspot) of 71.652 $kgCO_2e$/carton or 0.995 $kgCO_2e$/unit or 9.95 $kgCO_2e$/kg of ***Masking Tape*** respectively.

6. Conclusion

The carbon footprint (CFP) results for the ***Masking Tape*** manufactured by GTG Manufacturing Sdn. Bhd. with physical dimensions of 48mm X 18m, and equivalent weight of 100g is 10.20 $kgCO_2e$/kg of masking tape from cradle-to-gate. Most of the carbon emission was emitted from the winding process, contributing to 97.58% of the total emissions. At the same time, it should be noted that the product has a CFP value of 1.020 $kgCO_2e$/unit and 73.432 $kgCO_2e$/carton of ***Masking Tape*** from cradle-to-gate.

7. References

[1] International Standard ISO 14067: 2018; Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification-Principles and Framework

[2] Intergovernmental Panel on Climate Change, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

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