before NTEC

PROJECT PROPOSAL

I. PROJECT PROFILE	
A. Title of the Project	Ground Calcium Carbonates (GCCs) from Romblon Marble Wastes for Industrial Use
B. Proponent	Dr. Alfredo F. Fortu Jr. Dean, College of Engineering and Technology Collaborators: ▪ College of Arts and Sciences ▪ RSU Romblon Campus ▪ RSU faculty from various disciplines
C. Project Cooperators	Marble processors, LGU
D. Project Duration	1 year project implementation 1 years monitoring of outcomes
E. Total Project Cost	**Total Amount PhP 1,780,000.00** DOST MIMAROPA - PhP 1,610,000.00 RSU - PhP 170,000.00
II. PROJECT PROPOSAL	
A. Rationale	Romblon is known for its marble deposits that are at par with international standards. However, the market dominance of ceramic tiles in the late 90s resulted in the closure of several marble plants in the islands. Interest in reviving the industry, however, is gaining ground again. Marble is identified as the flagship priority R&D commodity of Romblon State University. The goal is to help the industry reposition itself and find its niche in the market by exploring the potential industrial uses of its wastes towards the industry's sustainable development. Currently, there are 11 marble quarrying sites and 33 cutting plants in active operation in the islands. One product that the University can develop from marble wastes is the ground calcium carbonates (GCC). As reported in the literature, GCCs can be used as fillers or extenders to manufacture paper, paint, plastic, rubber, adhesives, cosmetics, textile, sealant, coating, ink, and toothpaste. GCC is usually sourced from limestone, but the use of marble wastes as an alternative is an exciting area of exploration since both these rocks are made up of the same mineral contents. In this way, this project will strategically address the issue of marble waste mismanagement and its threat to the environment. Currently, marble chips and scraps are shipped out of the province for processing into GCCs. If there is a way that these wastes could be processed as GCCs within the province, its value would cost more, and the income of the local processors would improve.
B. Project Description	The proposal is a laboratory-scale project which involves the following activities: processing, characterization, testing and grading. Marble wastes such as rubbles, fine powder, slurry, dust, and mud

	from different marble types will be grounded down to the nano-size range to produce the GCCs. GCCs will be characterized and tested for various parameters for grading purposes. The graded GCCs will be matched with the industry requirements and specifications for potential commercialization and R&D purposes.
C. Objectives	This project is proposed to develop GCCs from marble wastes for industrial purposes. Especially, this will address the following objectives: 1. Convert quarrying and processing wastes into GCCs down to the nano-size range; 2. Characterize the physical and chemical properties of the processed GCCs based on the standard parameters in the industry; 3. Compare and grade the characteristics of the GCCs across the marble type source. 4. Tie up results of the project to GCC-based manufacturing industries for potential commercialization and R&D purposes.
D. Scientific Basis/ Theoretical Framework	There is a worldwide call to reduce, reuse, and recycle. In the Philippines, Republic Act 9003 or the Solid Waste Management Act of 2000 mandates LGUs and BLGUs to promote the beneficiation of wastes. Romblon, being dubbed as the Marble Industry of Romblon, generates waste materials as with other marble plants from the various production processes both in the mine site and processing/polishing plants (Sezer 2013) which cause air and water pollution problems in the surrounding areas. However, these wastes can be recycled, reused, or treated/processed and transformed into valuable products or raw material as fillers or extenders for the manufacturing of paper, paint, plastic, rubber, adhesives, cosmetic, textile, sealant, coating, ink, and toothpaste (Vu, 2018; Marras et al.,2017; Sezer, 2013; IMA Europe, n.d.). The generation of wastes from the marble industry has two main stages, namely: in the form of fragments, chips or shapeless blocks which do not have commercial value; and in the form of a fine powder, dust, slurry or mud produced during cutting, sawing and polishing (Sezer, 2013). Previous studies emphasized that these marble chips or marble dust particles usually contain pure CaCO3, which can be used as an alternative source for ground calcium carbonate production (GCC). According to Vu (2018), GCC is produced from further treatment to process natural CaCO3 of the highest quality after mechanical grinding of the raw material, limestone or marble. No chemical change is involved in the process. The utilization of both GCC depends on the particle size, color and chemical purity. The production of GCC involves crushing and processing marble to create a powdery-line form graded size suitable for different industrial and pharmaceutical applications. In terms of physical and chemical analysis, the marble slurry is tested for the following properties (Sezer, 2013): (a) Physical properties – bulk density, specific gravity and particle size; (b) Chemical

<table>
<tr><td></td><td>properties – CaO, SiO_2, Al_2O_3, Fe_2O_3, MgO, Na_2CO_3 and K_2SO_4, loss on ignition (LOI). The marble waste characterization is performed to determine if a waste needs to be managed as hazardous or inert waste. These physical and chemical properties are also determined using various analyzers and scanning equipment, mainly to analyze the marble particles' morphological quality and mineral characteristics (Marras et al., 2017).

Characterizing the marble waste is vital to determine its re-usability for other processes and identify the feasibility of using marble waste to produce GCC for industrial applications (Marras et al., 2017). But most importantly, the environmental and economic benefits of utilizing these marble wastes into a high-quality source of $CaCO_3$ to gain additional economic value; and to reduce or minimize the disposal of these untreated marble wastes to water bodies and other land-based disposal facilities.</td></tr>
<tr><td>D. Methodology</td><td>Quarrying and processing plants for marbles will be identified and geo-tagged. Different types of marbles (e.g., gray, black, and white-colored) will be collected at the sampling sites and brought to Romblon State University-Main campus for grinding. Ground samples will be dried in an oven at a temperature of 110 ± 5 °C until they reached the constant weight.

Dried samples of ground marbles will be sent to analytical laboratories through One Lab to determine their physical, chemical, mineralogical and morphological properties. The analysis will include grain size distribution, bulk density, specific gravity, color and brightness, hardness, leachable chlorides, acid solubility, pH, chemical composition (inductively coupled plasma atomic emission spectrometry, ICP-AES), mineralogical composition (X-ray diffraction analysis, XRD), and morphological quality (scanning electron microscope, SEM) of marble particles. The possible use/s of ground marbles will be identified based on the properties of the ground marbles.</td></tr>
<tr><td>E. Business Plan</td><td>Should the GCCs from Romblon marble passed the industry standards, a new economic activity may open between and among the marble quarrying operators, processors and industrial users.

It will also invite potential investors in the islands, which will affect the investment plan and directions of the local and provincial government units concerning the marble industry and make the necessary policies to support the industry.</td></tr>
<tr><td>F. Activity Schedule</td><td>The project team will follow the following timetable:

<table>
<tr><td>Activity</td><td colspan="2">2021</td><td colspan="4">2022</td></tr>
<tr><td></td><td>3Q</td><td>4Q</td><td>1Q</td><td>2Q</td><td>3Q</td><td>4Q</td></tr>
<tr><td>Consultation and meetings</td><td>x</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project proposal preparation</td><td></td><td>x</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project proposal review</td><td></td><td>x</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Revision, approval and MOA signing</td><td></td><td></td><td>x</td><td></td><td></td><td></td></tr>
<tr><td>Fund release</td><td></td><td></td><td>x</td><td></td><td></td><td></td></tr>
</table></td></tr>
</table>

Procurement of equipment and supplies			x	x		
Collection of samples				x	x	
Characterization, testing and grading					x	
Completion and report preparation					x	
Tie up with the industries						x
Liquidation						x
Report presentation						x
Monitoring			x	x	x	x

Monitoring and evaluation would be made by the PSTC so that the performance objectives may be assessed.

G. Budget Breakdown

The following line-item-budget would be followed for the project:

ITEM	DOST-GIA (P)	RSU (P)
MOOE		
Traveling Expenses – local (including RAT test)	60, 000.00	20,000.00
Supplies and Materials	60,000.00	30,000.00
Other Professional Services	268,800.00	
(@P1400/day x 2 days/ week x 4 weeks/month x 12 months x 2 researchers)		30,000.00
Representation Expenses	50,000.00	
Other Professional Services (Test Fee, One Lab)	461,200.00	40,000.00
Communication (300/mosx12mos/yrx10)	6,000.00	30,000.00
Transportation and Delivery Expenses (for sending samples to one Lab)	20,000.00	20,000.00
Equipment Outlay		
1 unit Lab Ball Mill, Volume: 1L*4, Stainless Steel, Maximum Loading capacity of jar: No more than 2/3 of the jar volume(including the material and the balls), input size; 10 to 0.1 micron, rotational speed; revolution 335r/min, rotation 670r/min, way of speeding: inverter stepless speed regulation, speed precision is 0.2r/min, way of drive: gear drive, motor power:750w, 220v, 50Hz, way of working: work with 2 or 4 jars simultaneously, input size <10mm, output size:13-75 micron, maximum continuous working time: 72h	582,500.00	
1 unit Laptop CPU： Processor： Intel i5-5257U Core/Threads： dual core four thread Core Architecture： GHz： i5-5257U 2.7Ghz,support Turbo Boost technology,max to 3.1GHz acceleration technique： Depends on CPU third level cache： 3M storage device: Memory: 8G DDR: DDR3L 1333/1600【SODIMM x 2】 hard disk type: SSD (m.2 2280*1&2242*1， pcie SSD Gen*4) &HDD hard disk interface: NGFF M.2 PCIE Gen*4 SSD:256G HDD: Can be added by yourself display screen： scree dimension： 15.6" inch Resolution： 1920*1080 LCD ： EDP high resolution screen； LED backlight；16：9 display card ： vedio card type1： Intel® Iris® Graphics 6100 VRAM size： 300MHz~1.1GHz Graphics Video Max Memory： 16GB Media device： camera： HD 720P with 2 * Internal digital Array Microphones loudspeaker： 2*2W High quality double stereo Speaker inside Built-in Microphone： 1 * Microphones (Option) communication： wifi： 802.11 A/C WIFI + Bluetooth Module WIDI： Depends on WIFI Module bluetooth： 4.0 Input/Output ： Input Device： Touchpad（Option：Touch fingerprint reader）， keyboard： US\UK ；Backlight with white LED lighting；Full size Ports： Headphone / microphone combo others： battery： Li-Polymer 4 Cell,Pack Capacity:70Wh adaptor： 100-240V / 50-60Hz,19V DC 2.1A ,40W adaptor Battery Life ： FormFactor： Clamshell， 140° Dimensions： machine：356*240*15 MM， packing 425*278*90MM weight： net G 1.83 KG - G 2.67 KG A\B\C\D cover： Metal：ACD,PC+ABS:B color： Grey/Gold	41,500.00	

PARTICLE ANALYZER Detecting type: Photoelectric **Measuring range:** (10-1000) mg/m^3 (customized) **Display accuracy:** ≤±20% **Voltage Range:** DC24V±10% **Sampling:** Diffusion **Power consumption:** ≤3W (DC24V) **Output:** 4~20mA (mA). GND(OP)and (COM, NO) output .H-alarm/L-alarm is adjustable **Communication (optional):** 4 wire ABUS 3 wire 4~20mA /RS485 (wire/wireless) /LoRa(wireless) **Communication range:** Range (wire)≤ 1000 m(1.5mm^2) wire Range(wireless)≤3500 m **Ex mark :** Ex ib IIB T4 Gb/Ex ibD 21 T130°C **IP ratting:** IP6X **Enclosure material:** Aluminum alloy. 304 Stainless steel. Tempered glass **Cable entries:** G3/4Internal screw thread **Temperature-Humidity Range:** -40℃~+70℃, ≤85%RH **Operating Pressure Range:** 86kPa~106kPa **Temperature measurement precision:** ±0.5℃ (-40℃-120℃) **Humidity measurement precision:** ±3%RH (0-100%RH) **Temperature resolution:** 0.1℃ **Humidity resolution:** 0.1%RH **Display type:**2.5 inch LED.4 and 5 Bit Nixietube. 8-Segment Numeric +Graphical display **IR control range:** <8m **Expected Operating Life:** 2 years **Low-alarm:** 50mg/m^3 (Factory default) **High- alarm:** 100mg/m^3 (Factory default) **Response time:** <30s(T90) **Output range:** ≤30V, 2A(maximum Limiting current) **Weight:** 2.2Kg **Circuit protection:** Over-range protection circuit**Dimension:** 280mm× 160mm× 90mm	60.000.00	
Total	**1,610,000.00**	**170,000.00**

The RSU counterpart would be the travel of faculty to the quarrying sites, representation expenses during meetings of the research team, testing fee of the samples, communication expenses of the researchers' paper and supplies.

H. Project Management	The research will be implemented by the RSU Romblon Campus, CAS, CET, and other faculty researchers in the University. CET is the lead unit, with the Dean as the project leader. The project will be implemented in cooperation with the PSTC Romblon. DOST MIMAROPA will fund the project and assist in the procurement of necessary equipment and supplies.
I. Expected Output	*Products.* Product will be GCC in the nanoparticle size ranges with corresponding physical, mechanical and chemical properties of samples from 3 different marble types. *People.* One master's degree graduate will be considered for this research. This will come from a faculty co-operator of this research, and this will also open opportunities for marble processors in the province. *Places and partnerships.* Industry partners in the paint and construction sector will also be tapped. *Publication.* At least one paper for publication in a Scopus- indexed journal will be considered. Another knowledge product that could be copyrighted is the documented process for producing the Ground Calcium Carbonate (GCC). *Protection.* An application for patent, utility model or industrial design, whichever is applicable, will be made to protect intellectual property.

	Policy. Policy for marble waste utilization or marble resource value addition right here in the province for possible local investment in the industry.
J. Monitoring and Evaluation	The DOST PSTC Romblon will make monitoring and evaluation. M&E will be centered on project deliverables as listed in the expected output.

K. Literature Cited

IMA Europe (n.d.). Calcium Carbonate. Retrieved from https://ima-europe.eu.

Marrass, G. Bortolussi, A., Peretti, R. and Careddu, N. (2017). Characterization methodology for reusing marble slurry in industrial applications, Energy Procedia, 125, 656-665. DOI: 10.1016/j.egypro.2017.08.277. Retrieved from https://doi.org/10.1016/j.egypro.2017.08.277

Sezer, N. (2013). Production of Precipitated Calcium Carbonate from Marble Wastes, A thesis submitted to the Graduate School of Natural and Applied Sciences of Middle East Technical University. Retrieved from https://etd.lib.metu.edu.tr/upload/12616347/index.pdf

Vu, T. (2018). The differences between ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC). Retrieved from https://www.linkedin.com/pulse/difference-between-ground-calcium-carbonate-gcc-precipitated-thu-vu.

Prepared by:

ALFREDO F. FORTU, JR.
CET DEAN