RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

Eco-Solution Waste Management Potential Impact on the Environment, Social, and Economy in Plastic and Ceramic Local Industries

By

Nor Azah Abdul Aziz
Fakulti Pengurusan Teknologi dan Teknousahawanan,
Universiti Teknikal Malaysia Melaka Corresponding Author Email: azahaziz@utem.edu.my

Mohammed Hariri Bakri
Fakulti Pengurusan Teknologi dan Teknousahawanan,
Universiti Teknikal Malaysia Melaka Email: hariri@utem.edu.my

Ihwan Ghazali
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
Email: ihwan@utem.edu.my

Atirah Sufian
Fakulti Pengurusan Teknologi dan Teknousahawanan,
Universiti Teknikal Malaysia Melaka Email: atirah@utem.edu.my

Johanna Abdullah Jaafar
Fakulti Pengurusan Teknologi dan Teknousahawanan,
Universiti Teknikal Malaysia Melaka Email: johanna@utem.edu.my

Nurul Nadia Ismail
Fakulti Pengurusan Teknologi dan Teknousahawanan,
Universiti Teknikal Malaysia Melaka Email: nurulnadia209work@gmail.com

Mathiyalagan a/l Elloo
San Miguel Yamamura Plastic Films Sdn Bhd, 75450 Ayer Keroh, Melaka, Malaysia
Email: mathi@smypf.com.my
Golden Clay Indusries Sdn Bhd, 83700 Batu Pahat, Johor, Malaysia

Elangeshwaran Muthusamy
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
Email: elangeshwaran.muthusamy@bmigroup.com

Abstract

Eco-solution waste management refers to the comprehensive management of activities that allow for the segregation of solid waste at source, the segregated transport, storage, transfer, refining, treatment and disposal of solid waste and all other activities that do not affect the environment in the management of waste. The volume of plastic waste has been increasing worldwide as plastic is one of the materials present in daily lives, since it is used as it is cheap, flexible, lightweight and durable for a number of purposes. Other than that, ceramic waste or construction waste is known to be one of the key causes of environmental and health problems, such as asbestos, which is produced and can be dangerous during demolition works. All industries should use the best alternatives way to manage all the waste properly and efficiently in order to avoid environment pollution that can harm the others. Thus, this paper aims to discuss on the current waste management practices and impact, the perception of waste recycling process or eco-solution waste management and potential impact, and to develop a recycling strategy for environment, social, and economy improvement in plastic and ceramic local industries. This case study is using a qualitative research method by doing a semi-structured interview, data transcription as well as thematic approach to find the results that are related to the research objectives. Findings shown that plastics and ceramics industries have tried their best to manage waste. The impact of these activities is positive for the environment, economy, and social of their companies even though it is not much. They have certain challenges, especially the high cost of waste recycling process. They agree with the recycling processes to improve the current waste management activities and give expectations that the impact on the environment, economy, and social will be more positive. They also agree with the proposed future recycling strategies for plastic and ceramic industry. Hence, it is possible to cycle these wastes to create other new beneficial product of green concrete as proposed by this research program. The contribution of this research is it opens ways to use waste to create other beneficial products which is green concrete for better constructions and buildings.

Keywords: Eco-solution, waste management, plastic waste, ceramic waste, current waste practices, recycling strategies, potential impact, Environment, Social, and Economy

Introduction and Background

The significant contributors to the high volume of waste created and disposed of annually are urbanisation and changing human lifestyles. There are human activities that produce waste in the manufacture of goods and after use. However, all these waste are mainly handled through disposal in landfills (Awoyera and Adesina, 2020). According to National Solid Waste Management Department of Malaysia, a study estimated that Malaysia created 0.94 million tonnes of plastic waste that was mismanaged, 0.14 to 0.37 million tonnes of which could have been washed into the oceans. The possible health effects of single-use plastics on humans and animals have also been highlighted by some research. Moreover, plastic products have become an integral part in daily life as a basic need. The increased use of plastic products as packaging application in the recent years has increased the quantity of plastics in the solid waste stream to a great extent (Babafemi, A.J et al., 2018). Its broad range of application in films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials. Plastic waste management involves activities associated with generation, storage, collection, transportation, processing and disposal. Other than plastic, ceramic materials contribute the highest percentage of wastes within the construction and demolition wastes i.e. about 54% (Er. Akash Agrawal et al., 2016). The quantum of solid waste is ever increasing due to increase in population, development activities, changes in life style, and socio-economic conditions.

Plastic and ceramic waste disposal in an environmentally sustainable manner should be achieved by adopting principles of economy, aesthetics, and energy conservation and pollution control. It encompasses planning, organization, administration, financial, legal and engineering aspects involving interdisciplinary relationships. The recycling of plastic and ceramic waste can be a positive contribution to a sustainable development, integrating environmental, economic and social aspects. In handling a business, the industries must have the knowledge regarding the waste management first in order to ensure that the operation from the raw materials until the end products and the waste are being manage very well. This action will help to boost the operation management of the company so that there will be no issue to stop the productions because of the problems occur from the waste disposal that had been made by the company. It means that, all the management including the waste of plastic and ceramic products are under a good well which will not affect the environment and social as well. Therefore, this case study is to understand and explore the current waste management practices and impact, the perception of waste recycling process and potential impact, and to develop a recycling strategy for environment, social, and economy improvement in plastic and ceramic local industries.

The scope of this study is focusing on the current waste management practices and impact, the perception of waste recycling process and potential impact, and to develop a recycling strategies for environment, social, and economy improvement in plastic and ceramic local industries. These are because the percentage of waste produced everyday especially in plastic and ceramic industries are increasing without having a proper disposal of these waste. Industries must understand that if they are producing some products to be used for certain purposes, they should be aware that the waste from the productions must be managed very well too. This is to prevent any pollution occur towards the environment especially in the marine ecosystems whereby lots of plastics are found in the sea. This action might also be the cause of death for marine life such as turtles, whales and others which are also facing as an endangered species in the world. Other than that, the air pollution also is being one of the most environment pollution in these days as majority of the manufacturers will dispose the waste of plastics just by burning it openly into the air without having other best alternatives to dispose it. This open burning will not just effect for the environment, but it will also effect for all the human being because all living things need fresh air to breathe otherwise some of them might get asthma and haze can be occurred to the environment that will make all of them difficulty in breathing. In addition, the respondents of this case study are from San Miguel Yamamura Plastic Film Sdn Bhd in Melaka and Golden Clay Industries Sdn Bhd in Johor.

Theoretical Framework

Plastic Waste

Waste plastics are becoming a significant stream in solid waste as a result of increased production. Plastic waste is the third most common form of municipal and industrial waste in cities, after food waste and paper waste. Owing to increased use of plastic packaging, plastic shopping bags, PET bottles, and other goods or appliances with plastic as a major component, even cities with low economic growth have begun to produce more plastic waste. This rise has posed a significant challenge for local governments in charge of solid waste management and sanitation (Bhattacharya et al., 2018). Most plastic waste is not collected properly or disposed of in an acceptable manner to prevent harmful impacts on the environment and public health, and waste plastics cause littering and sewerage system clogging due to a lack of integrated solid waste management. Waste plastic is often the most visible component in waste dumps and open landfills due to the exceptionally long periods needed for natural decomposition.

Furthermore, plastic is adaptable, lightweight, flexible, moisture-resistant, sturdy, and reasonably priced. These are the alluring qualities that have led to such a voracious appetite for and overconsumption of plastic products all over the world. Plastic materials, which are durable and slow to degrade, are used in the manufacture of a wide range of items, but they eventually become waste. Plastic waste is one of the least understood and most controversial aspects of plastic's environmental effects. One of plastic's most attractive characteristics, its toughness and resistance to decomposition, is also one of its biggest liabilities when it comes to plastic disposal (Sharma and Mallubhotla, 2019). Natural species struggle to break down the synthetic chemical bonds in plastic, posing a significant problem with the material's persistence. Just about 10% of overall plastic output is effectively recycled; the rest is sent to landfills or incinerators, where harmful materials are spewed into the environment and accumulated in biotic forms in the surrounding habitats for hundreds of thousands of years.

Current Waste Management Practices in Plastic Industries

Landfill, on the other hand, is Malaysia's preferred method of solid waste management, with 85 percent of materials going to landfill; this high percentage is due to the low cost of this method of solid waste management (Awasthi et al., 2017). Plastics, unlike food and paper wastes, cannot be permanently removed from the atmosphere when left to decay in landfills, which is a major concern for their disposal in the solid waste management cycle. Plastics, also known as micro plastics, take hundreds to thousands of years to break down into tiny plastic particles.

Additionally, several studies have contrasted incineration and recycling in terms of cost-effectiveness. According to Lea (2016), incineration maximize energy cost savings in terms of energy usage and can reduce landfill dependency. Although other researchers have found similar results, Morris (2017) discovered that recycling plastic waste uses much less energy and has a lower environmental impact than landfilling or incineration. This is because, despite having technology to filter out most air contaminants, incineration plants are expensive to construct, and importing plastic waste is often needed to ensure a steady supply for an economically viable incineration plant production activity (Abdel-Shafy and Mansour, 2018). While energy consumption and emissions are necessary for recycling, it allows for a reduction in overall fossil fuel usage and minimises overall carbon dioxide emissions. Overall, the societal benefits of recycling, such as improved human wellbeing, vastly outweigh the costs.

Moreover, there are a number of theoretically feasible mechanisms for improving plastic degradability. The main processes currently being researched and commercialised are biodegradation and photo degradation. Incorporating starch additives into plastics has become the most popular process for improving biodegradability. The use of photo-sensitive carbonyl groups or the inclusion of other photo-sensitive additives are used in the production of photodegradable plastics (Kwesiga, 2018). The concerns surrounding degradable plastics must be resolved before these technologies can be promoted.

Perception of Waste Recycling Process in Plastic Industries

Plastic goods can be used in large quantities in both the workplace and the home. Plastic and plastic product pollution can damage and pollute the terrestrial ecosystem, which can then be transferred to the aquatic environment. Despite the fact that about 80% of plastic waste at sea comes from land-based sources, there is a scarcity of data on the volume of plastic waste on land in contrast to the vast amount of data available on plastic debris in marine habitat (Hahladakis et al., 2020). Plastic additives such as stabilisers, harmful colourant moieties, plasticizers, and heavy metals can leach and eventually percolate into various aspects of the environment, resulting in soil and water pollution. Dumping plastics on land or landfilling plastics results in abiotic and biotic degradation of the plastics, where plastic additives such as stabilisers, harmful colourant moieties, plasticizers, and heavy metals can leach and eventually percolate into various aspects of the environment.

Moreover, when landfilled plastic waste decomposes, carbon dioxide and methane are released into the atmosphere. In 2008, an estimated 20 million tonnes of CO2 equivalent (eqCO2) was released into the atmosphere during the decomposition of solid waste in landfills (Kong et al., 2017). CO2 is also emitted into the atmosphere as plastics and plastic goods are burned, and this CO2 has the ability to absorb radiant heat and prevent it from leaving the planet, resulting in global warming. Air pollution is one of the most serious environmental risks to public health, with more than 6 million people dying as a result of it each year. In addition, when plastics and plastic goods are burned openly, contaminants such as heavy metals, dioxins, PCBs, and furans are released into the air, posing health risks, especially respiratory problems. Plastics' position in air pollution in developed and poor countries cannot be overstated, and the consequences for future generations may be devastating. Plastic polymers are commonly thought to be inert and of little interest to public health; however, various forms of additives and residual monomers likely retained from these polymers are suspected to be the source of the health risks. The majority of plastic additives are known carcinogens and endocrine disruptors (Hojnik et al., 2019). Humans are exposed to these additives primarily through ingestion, skin contact, and inhalation.

Waste Recycling Strategies in Plastic Industries

By establishing a recycling system for plastic waste, a local industry will emerge and recover value from the recycled material. Energy recovery is the only way to make money where there is no recycling. On the other hand, plastic waste recycling systems are more logistically complex than conventional waste processing systems, resulting in higher waste management costs. Producers and buyers of plastic products must pay this extra expense by extended supplier liability (EPR). Since raw plastic needs crude oil or natural gas, developing this activity also helps to provide resource independence to countries with little oil or gas resources (Mwanza et al., 2018).

Next, manufacturers must improve eco-design and recycled plastic use. Only products that are designed with recycling in mind can be recycled in a cost-effective manner. When dealing with products that use multi-layer plastics, such as various polymers or fabrics, recycling becomes much more complicated. Recycling is made easier when single-layer plastics are used. Furthermore, since they exist in insufficient amounts in waste streams, some technically recyclable polymers are not recycled in practice. This demonstrates how recycling is encouraged when producers use polymers that are already widely used on the market and for which recycling schemes are already in place (Jereme et al., 2015). This is often when decisions are made on whether or not to use recycled plastic in a product. Recycled resins are often hampered by odour or colour issues. As a result, it is difficult to come up with a substitute that is exactly the same as raw resins. Furthermore, it is important to consider these limitations during the product creation stages, which are overseen by the organisational marketing departments in charge of the products' life cycles. Plastic manufacturers who are expected to use recycled resins in their products must also overcome the technological challenges of increasing the amount of recycled content in their products.

Additionally, recyclers and waste management professionals can improve system efficiency and recycled plastic quality. Sorting technology advancements allow for more efficient sorting of materials as well as the processing of new flows with higher yields. Artificial intelligence is being used by some of the most recent sorting robots to develop their ability to identify waste. The sector will also benefit from the scaling effect that can be accomplished by centralising sorting and processing (d'Ambrières, 2019). The resulting marginal reduction in production costs per metric tonne of recycled plastic may assist in propelling the industry forward. In the areas of selection, sorting, and distribution, efficiency improvements are possible.

Ceramic Waste

Many buildings use ceramic products as part of the basic construction materials. Wall tiles, floor tiles, sanitary ware, domestic ceramics, and scientific ceramics are all examples of manufactured ceramics. They are mainly made out of natural materials with a lot of clay minerals in them. Despite the decorative advantages of ceramics, this wastes cause a great deal of environmental pollution among other things. Ceramic waste is divided into two groups based on the origin of the raw materials. One category is created by fired ceramic wastes produced by structural ceramic factories that use only red pastes to manufacture their products (brick, blocks, and roof tiles). The second category includes stoneware ceramic wastes that have been fired (wall, floor tiles and sanitary ware) (Paul O. Awoyera et al., 2018). Meanwhile, studies have shown that about 30% of the material used in ceramic processing ends up as waste, which is actually not being used to its full potential. This emphasises the importance of pursuing novel approaches to repurposing ceramic waste.

Moreover, concrete is one of the most widely used construction materials on the planet. Concrete is made up of three main components: cement, water, and aggregates. Both fine and coarse aggregates account for 65-75 percent of the volume of concrete and are essential ingredients in the manufacture of concrete. Aggregates can be obtained naturally or artificially, depending on their origin. Natural aggregates are obtained from quarries and riverbeds through the processing of crushed rocks, while artificial aggregates are obtained from factories through blast furnace slag. Rapid industrialization causes serious problems all over the world, such as natural aggregate depletion. This problem is solved by repurposing building waste from various industries. Ceramic waste products are disposed of in a landfill, and when they come into contact with ground water or the sand, it will produces harmful effects (Tadesse, 2020).

Current Waste Management Practices in Ceramic Industries

The world's increasing economy necessitates an increase in industrial production to meet the needs of a growing population. It is causing two types of problems in the ecosystem which are pollution and unsustainable waste, as well as the disappearance of natural resources. One way to mitigate these issues from an economic perspective is to recycle these manufacturing by-products or wastes as main streams of industrial output. As a result of this realization, every manufacturing sector is attempting to increase profits by reducing the exploitation of virgin resources and incorporating waste into goods (Saadi Nurzalikha et al., 2016). In this regard, the ceramic industries have favourable conditions for the use of byproducts or wastes in their manufacturing processes. As a result, several studies have been conducted in the ceramic industries over the last two decades to achieve this aim. Other than that, some ceramic wastes have been identified as potential materials for repurposing in the production of various ceramics. Following that, several studies were discovered to analyse the value of wastes in the formulation of various ceramics.

Andreola et al. (2016) provide a brief overview of the use of fluxing, plastifying, and fuel wastes in the production of ceramics, primarily tiles and bricks. The role of glass wastes in the production of tiles and bricks, as well as the degree of waste addition, are also addressed. Silva et al. (2017) go into great detail regarding the storage and disposal of glass waste. Ceramic-based goods such as tiles, glass-ceramics, bricks, foams, porcelain, and glazing are made with it as a secondary raw material. Vieira and Monteiro (2009) divided wastes into three categories: fuel wastes that affect the sintering process of ceramics, fluxing wastes that include alkaline and alkaline earth compounds and affect sintering temperatures by forming liquid phases, and property-affecting wastes that change the behaviour of ceramics.

Perception of Waste Recycling Process in Ceramic Industries

Ceramic is an exceptionally durable material with an approximate lifespan of more than 50 years and is easy to recycle or recover in processes that reuse fired and unfired waste and demolition waste in compliance with a CE vision due to its inherent characteristics such as tolerance to extreme atmospheric conditions, contaminants, humidity, temperature fluctuations, and UV rays (FISSAC, 2020). To meet consumer demands, product sizes and thicknesses are being created, which has an impact on overall environmental characteristics. The development of low-thickness ceramic goods, in particular, decreases the amount of raw materials used (dematerialisation), as well as transportation costs and energy costs per square metre.

However, ceramic factories generate massive quantities of waste each year during various stages of development, a situation that is linked to a number of environmental issues related to land filling. Since the majority of these wastes have not yet been adequately used, incorporating them into the production of ceramic tiles as an alternative raw material would aid in the conservation of natural resources, the reduction of production costs, and the production of an eco-friendly ceramic floor tile at a lower cost (Elmahyarv et al., 2018). These wastes may sometimes be recycled into raw mix equipment, but this is more of an exception than a rule. Ceramic sludge, partially or completely fired defective articles, and powder formed from kiln roller grinding are examples of waste materials that are commonly disposed of by land filling. Apart from financial losses, this poses a danger to the environment, particularly in the case of sludge, where the liquid diffuses across the surface, impacting natural aquifers (Bakri et al 2017).

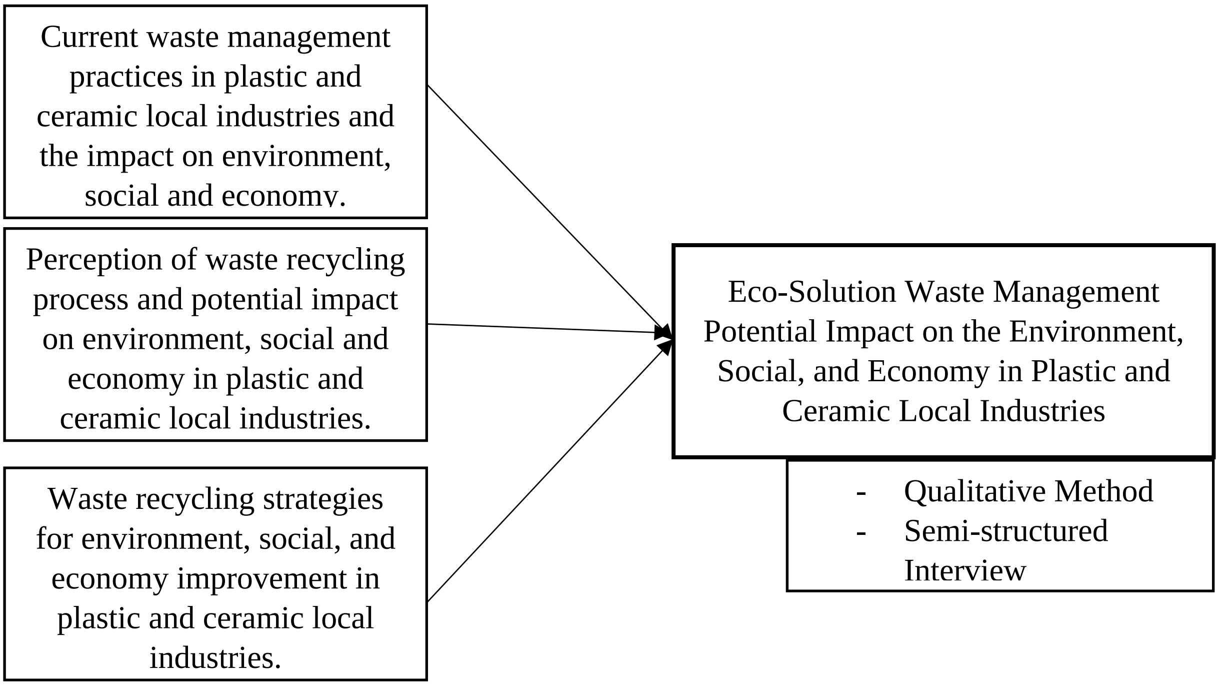
Moreover, unlike other industries, the ceramics industry is able to reuse the majority of the waste produced during the manufacturing process. Most manufacturing residues such as unfired waste tiles, fired waste tiles, washing line sludge, polishing and honing sludge, dried milling residues, and exhausted lime can now be reintroduced into the ceramic production process in place of other raw materials, thanks to the improvements in production technology (Vázquez et al., 2017). This saves thousands of tonnes of natural materials including sands, feldspars, alumina, zirconium oxide, mullite, and clays from being extracted, transported, and used. Other than that, incentivizing the reuse of materials in the ceramic industry often results in a significant decrease in heavy vehicle movements used to transport raw materials, saving fossil fuels and helping to minimise greenhouse gas emissions. A corresponding amount of material is withdrawn from the waste cycle at the same time.

Waste Recycling Strategies in Ceramic Industries

Bricks have a life expectancy of over 200 years. Bricks and blocks that have historically been used in the construction of homes, walls, paving, and utilities, such as bridges and sewers, can be reclaimed or recycled. Items destroyed during unloading, storage, and cutting, as well as excess due to overordering, are the most common sources of brick and block waste. All of these manufacturers will salvage undamaged bricks and blocks and use them in new construction projects or sell them to reclaimed brick businesses. For examples, aggregate for use as general fill or highway sub-base in landscaping, new bricks and blocks, sports surfaces such as tennis courts and athletic tracks, and plant substrate (Saadi Nurzalikha et al., 2016). Next, recycling floor and wall coverings from construction projects such as carpet, carpet tiles, vinyl and linoleum, laminate, flooring, wood, ceramic and terrazzo tiles, wall paper can be sell to other businesses. For example, carpet fibres are recovered as plastics recyclate and sold on to the plastics and horticultural markets by social enterprises that recondition and refurbish floor and wall coverings, as well as specialist recycling services that recover carpet fibres as plastics recyclate and sell on to the plastics and horticultural markets.

In addition, it is not new to use waste products from the mining industry as ceramic additives and waste materials can impart beneficial properties during the fabrication process. On the other hand, ceramics made entirely from waste are becoming more popular. The study collected samples of granite sawing waste from local companies in the Paraba region of Brazil and characterised them to determine their density, particle size distribution, surface area, and chemical composition. Their ceramic composition was also checked to see whether they could be mixed into the mix for use in ceramic bricks and tiles. The study found that granite wastes have physical and mineralogical properties close to those of traditional ceramic raw materials, suggesting that they may be a significant source of waste reduction (UNIDO, 2019). Further research has shown that waste materials have the ability to be used as more than just an additive in the ceramics industry which they may be the only raw materials used in their production. Exploratory research in Brazil and Portugal concentrated on making porcelain-like ceramics for the construction industry, specifically floor tiles, but researchers claim it could be applied to any part of the industry using other forms of waste. Therefore, clay-mining tail, sludge from potable water treatment, and sludge from gneiss which is a widely distributed form of metamorphic rock and variety stone-cutting processes were examined as well as chemical and mineral composition, thermal activity, and particle size distribution were characterised. The study demonstrated the clear environmental and financial benefits (Faique et al 2017). There is no need to dispose of waste as it is recovered and recycled, and it is also less expensive than using raw materials. Energy costs were the same if recycled waste or raw materials were used.

Theoretical Framework



<Fig. 1.2> Theoretical Framework

Based on the above theoretical framework, it can be explained that this case study is using qualitative method and semi-structured interview to study the current waste management, perception of waste recycling process and waste recycling strategies for environment, social, and economy improvement in plastic and ceramic local industries that lead towards the eco-solution waste management in the targeted industries as the topic of this study.

Related Theory

The researchers will present some of the theories connected to the topic research in this section. The related theories are Protection Motivation Theory (PMT) and Theory of Change (ToC). These two theories are incorporated in this study in order to obtain more accurate results and understandings, as well as to reinforce the researchers' topic.

Protection Motivation Theory (PMT)

Rogers proposed the Protection Motivation Theory (PMT) as a conceptual framework for explaining factors that predict risk-avoidance actions. Individuals' decisions to engage in risk-avoidance activities are based on their desire to protect themselves from hazards such as natural disasters, global climate change, and nuclear explosions, according to PMT (Janmaimool, 2017). People weigh the risks and advantages of various options. The decision is made based on the threat and coping appraisal results. Individuals employ threat evaluation as a cognitive process to estimate the level of threat.

PMT is most commonly used to explain why people choose to engage in health risk reduction and disaster prevention practises. PMT has also been used to explain pro-environmental behaviour by a number of researchers. Many PMT features, such as the perceived severity of climate change effects, perceived response efficacy, and self-efficacy, were found to have a substantial impact on people's intention to engage in pro-environmental behaviours, according to Kim et al (2013) and Marquit et al (2008), they looked at how citizens' perceptions of air pollution concerns and hazards to human health influenced their participation in pro-environmental behaviours, and found that people in general are interested in the environment. It need less physical effort to complete for example, driving fewer kilometres and avoiding idling than those that involve more physical effort like riding a bicycle and walking. PMT was also used by Keshavarz and Karami to investigate farmers' pro-environmental behaviour during a drought, and they discovered that PMT was linked to a variety of variables. Although a lot of studies have looked at using PMT to evaluate pro-environmental behaviour, this research focuses on eco-solution waste management for plastic and ceramic local industries.

Therefore, the Protection Motivation Theory (PMT) can be used as a related theory in this study because it is based on the important of the environment, health as well as the animals. People need to understand and list out the risk that might be happened if any method of the waste management that they have been using right now is safe for the environment, animals or our health or not. For example, if let say some of the manufacturers just want to burn the plastic waste, definitely it will cause air pollution, affecting the human’s health especially for the breathing system and it might cause acid rain that will be harmful towards the animals and historical architecture. Thus, this theory can be explained that there must be motivation in everyone to protect the surrounding so that there will be no bad outcomes based on what we have done today. It is like everyone must think the risk or the future outcomes on what will happen if the techniques or method used to manage the waste of plastic and ceramic are not eco-solution or whether that method can bring harmful or not towards the environment and others.

Theory of Change (ToC)

The Theory of Change (ToC) technique is widely utilised in development and is becoming more commonly employed in other fields. The notion first gained traction in the 1990s, and it has since grown in popularity and sophistication (Scientific and Technical Advisory Panel, 2019). Although there is still some disagreement about how a ToC should be defined, it is here described as the process and result of creating an explicit account of how and why an intervention is expected to achieve its desired outcomes and impact goal. It is based on a set of important causal routes deriving from the intervention's actions and outputs (whether at the programme or project level), as well as the assumptions that underpin these causal linkages.

There are several reasons to conduct a ToC, which can be divided into four categories:

Design

To make projects more effective, partially by bringing in various sources of expertise and by opening up ‘black boxes' in thinking through explicit causal pathways, to increase the likelihood of delivering long-term and transformative impact efficiently.

Engage

To assist teams in achieving a shared understanding of an intervention, as well as to assist in engaging and developing ownership among partners and stakeholders (including those important for durability and scaling).

Communicate

To quickly communicate the goals and actions of a project, both internally and externally, as well as to emphasise the change process.

Measure

To assist teams in learning through data gathering about gaps in the current evidence base, to allow adaptive adjustments to an intervention over time, and to guarantee success indicators are in place for future review (the reason most highlighted by evaluation offices).

Therefore, the Theory of Change (ToC) is related to this study because it explained that every problem available need to make some changes or improvement so that a solution can be found to overcome the problem statement as stated. As for this study, the problem statement is about the waste management on how to manage the plastics and ceramics waste to make it more eco-solution without bringing any harmful to the environment or pollution. So, the researchers need to find out what are the best solutions to overcome all these problems in order to make the changes for the public or even to the manufacturers to change their current waste management practices to a better solution.

RESEARCH METHODOLOGY

The method uses to conduct this study is by using qualitative research method. Qualitative research is a broad concept that encompasses a variety of research methods (Cropley, 2019). The term "research strategy" refers to a flexible set of methods for gathering accurate and reliable data. Therefore, qualitative methods place a greater emphasis on meaning, mechanism, and context, such as the "why" and "how," rather than the "how many." It can also generate data that is rich in depth, variance, context, multidimensionality and complexity (Fernandez, 2020). This is a humanistic or idealistic approach to research that focuses on interpreting a topic. While the quantitative approach is accurate because it focuses on numeric and methods that other researchers can objectively make and disseminate, the qualitative approach is also accurate because it focuses on non-numeric and methods that other researchers can objectively render and disseminate. Non-numerical data is generated by qualitative research, which is used to examine people's beliefs, expectations, behaviours, habits, and relationships (Mohajan, 2018).

Therefore, this study seeks to understand and explore the current waste management practices and impact, the perception of waste recycling process and impact, and to develop a recycling strategies for environment, social, and economy improvement in plastic and ceramic local industries. The targeted companies that will be studied are San Miguel Yamamura Plastic Film Sdn Bhd in Melaka and Golden Clay Industries Sdn Bhd in Johor. Other than that, this case study aims to analyse specific issues within the boundaries of a specific organizations. This case study is useful to explore ideas to prepare for the larger research program which is on green concrete as an eco-solution for plastic and ceramic local industries. Additionally, a case study is an appropriate research design when we want to gain concrete, contextual, in-depth knowledge about a specific real-world subject. It allows the researcher to explore the key characteristics, meanings, and implications of the case.

As for the data collection, the researcher will be using a semi-structured interview and secondary data. Semi-structured interview can be characterised as a qualitative research approach that incorporates a predetermined collection of open questions consisting of quickly discussed questions to encourage the interviewer to further explore specific topics or answers (Barclay, 2018). It also allow respondents to speak freely about the topic (Margaret C. Harrell; Melissa A. Bradley, 2019). DeJonckheere and Vaughn, 2019 describe interviews as a way of collecting research data 'in which one person, an interviewer asks questions of another person, a respondent, (and) are conducted either face-to-face or by telephone'. This method of data collection facilitates interviewees sharing their views, and explaining their reasoning and experiences regarding the issues being observed in this study. The main interview questions will be developed based on the research problems and research questions. However, this study will choose two techniques of semi-structured interviews which are face-to-face interviews and using an asynchronous communication method such as WhatsApp messenger or email. In addition to semi-structured interviews, this study will employ unobtrusive method-content analysis by examining and interpreting textual sources (Husband, 2020) such as reports and newspapers to extract further understanding of the issues to further support and justify the research findings.

Lastly, data transcription is an essential and necessary part of qualitative analysis. The term describes a process that converts an audio or video recording into words that can then be analysed and coded (Hennink & Weber, 2018). A transcription, on the other hand, may include a more representational approach that includes nonverbal behaviour, proxemics, pacing notes, tone of voice, inflections, and contextual significance among other things. In short, this method is a simple technique that requires the researcher to translate the audio or video recording into a written form so that the researcher can complete the data analysis in a report for this study using the thematic approach analysis. The conceptual framework for the thematic analysis of the interviews was primarily focused on the theoretical roles (Neuendorf, 2019). According to them, thematic analysis is a method for defining, evaluating, and reporting data patterns such as themes. A theme is described as a representation of some form of patterned response or context within the data set that captures the key idea of the data in relation to the research question. It can also be explained as involving inductive data exploration to identify common themes, patterns, or concepts, and then explaining and interpreting certain categories.

RESULTS AND DISCUSSION

The main objective of this research which is to investigate the current waste management practices in plastic and ceramic local industries. As the researcher had explained from the part before this, the interviewees that are chosen among the top management of each company which are under plastic and ceramic industry. Both of the company use some different method in order to manage the waste disposal in a proper way such as in Table 1.

<Table. 1> Current Waste Management Practices in Plastic and Ceramic Local Industries

San Miguel Plastic Film Sdn Bhd. Melaka (Mrs. A)	**Golden Clay Industries Sdn Bhd. Johor (Mr. B)**
Recycle	Recycle
Sell to waste collector in Melaka	-

Mrs. A responded that "Currently we are using the recycle method which is the very common for us in order to dispose the waste properly. We do the recycling process in a good and proper way to reduce any pollution that we can make during the process. This is because when we need to do the process, we need to use some chemical or mixtures of other materials to turn the waste into some new products that can be sell into the targeted market. This will also can be an opportunity for us to use as much as possible the raw materials and make some sales based on it. Other than that, we are also sell the waste to the waste collector around Melaka because some of them would want to do something with our waste. For example, like making a new invention or product that can be used in our daily life such as plastic vase and so on."

Mr. B explained that "Our company is producing products that are based from ceramics, therefore the current method that we are using now is only recycle. We do make products such as concrete and clay and the waste we manage it by recycling them into a new product that can be commercialize in the same industry. We will ensure that all the waste collected everyday are within the minimum level in order to avoid any over cost that we need to manage or settle it later. So far, I think this is the only method that we are using right now to manage our ceramics waste."

As written in the explanations above, the researcher can make an analysis based on the answers of the interviewees regarding the current waste management practices in plastic and ceramic local industries. For San Miguel Yamamura Plastic Film Sdn Bhd. Melaka and Golden Clay Industries Sdn Bhd. Johor, both of them are using the same method of waste management which is recycle. However, there is another method that San Miguel Yamamura Plastic Film Sdn Bhd. Melaka use in order to manage their waste is by selling it to waste collector in Melaka.

Additionally, several studies regarding the recycle of plastics have contrasted incineration and recycling in terms of cost-effectiveness. According to (Chen et al., 2021), incineration maximize energy cost savings in terms of energy usage and can reduce landfill dependency. Although other researchers have found similar results, (Hopewell et al., 2009) discovered that recycling plastic waste uses much less energy and has a lower environmental impact than landfilling or incineration. This is because, despite having technology to filter out most air contaminants, incineration plants are expensive to construct, and importing plastic waste is often needed to ensure a steady supply for an economically viable incineration plant production activity (Abdel-Shafy & Mansour, 2018). While energy consumption and emissions are necessary for recycling, it allows for a reduction in overall fossil fuel usage and minimises overall carbon dioxide emissions. Overall, the societal benefits of recycling, such as improved human wellbeing, vastly outweigh the costs.

<Table. 2> Impact of Current Plastic and Ceramic Waste Management Practices

Impact of Current Plastic and Ceramic Waste Management Practices On COMPANY		
ENVIRONMENT	**PLASTIC**	**CERAMIC**
Pollutant emissions to air.	High	Average
Use of water and wastewater emission.	Low	Average
Use of energy.	High	Low
Use of toxic inputs.	Low	Low
Solid waste.	Low	High
Soil contamination and landscape damage.	Low	Low
Noise	Average	Low
Smell emissions.	Low	Low
Risk of severe accidents.	Low	Low
Others, please mention and explain.	-	-
SOCIAL		
Public image.	High	High
Employees' morale.	Very high	Average
Employees' social wellbeing.	Very high	Average

Employees' health wellbeing.	Very high	Average
Employees' lifestyle.	Very high	Average
Employees' job satisfaction.	High	Average
Employees' rewards and recognitions.	High	Average
Others, please mention and explain.	-	-
ECONOMY		
Sales.	High	Average
Market share.	High	Average
Short term profit.	High	Average
Long term profit.	High	Average
Cost Savings.	Low	Average
Return on investments.	Low	Average
Productivity.	Low	Average
Financial liquidity.	Low	Average
Others, please mention and explain.	-	-

Meanwhile, for the recycle of ceramic waste, the world's increasing economy necessitates an increase in industrial production to meet the needs of a growing population. It is causing two types of problems in the ecosystem which are pollution and unsustainable waste, as well as the disappearance of natural resources. One way to mitigate these issues from an economic perspective is to recycle these manufacturing by-products or wastes as main streams of industrial output. As a result of this realization, every manufacturing sector is attempting to increase profits by reducing the exploitation of virgin resources and incorporating waste into goods (Saadi Nurzalikha et al., 2016). In this regard, the ceramic industries have favourable conditions for the use of by products or wastes in their manufacturing processes. As a result, several studies have been conducted in the ceramic industries over the last two decades to achieve this aim. Other than that, some ceramic wastes have been identified as potential materials for repurposing in the production of various ceramics. Following that, several studies were discovered to analyse the value of wastes in the formulation of various ceramics.

Perception of Waste Recycling Process and Potential Impact

In this part, the researcher will describe the perception of waste recycling process and potential impact on environment, social and economy in plastic and ceramic local industries. From the interview session, there are some perception given by each of the industry regarding their waste management method in Table 3.

<Table. 3> Perceived Impact after Recycling of Plastic and Ceramic Waste

On COMPANY		
ENVIRONMENT	**PLASTIC**	**CERAMIC**
Reduction in pollutant emissions to air.	Very High	High
Reduction in use of water and waste water emission.	Very High	High
Reduction in use of energy.	Average	High
Reduction in use of toxic inputs.	Very High	High
Reduction of solid waste.	Very High	High
Reduction of soil contamination and landscape damage.	Very High	High
Reduction of noise.	Average	High
Reduction of smell emissions.	Average	High
Reduction in the risk of severe accidents.	High	High
Others, please mention and explain.	-	-
SOCIAL		
Increase public image.	Very High	High
Increase employees' morale.	Very High	High
Increase employees' social wellbeing.	Very High	High
Increase employees' health wellbeing.	Very High	High
Increase employees' lifestyle.	Very High	High
Increase employees' job satisfaction.	Very High	High
Increase employees' rewards and recognitions.	Very High	High

Others, please mention and explain.	-	-
ECONOMY		
Increase sales growth.	Average	Average
Increase growth in market share.	Average	Average
Increase short term profit.	Average	Average
Increase long term profit.	Average	Average
Increase cost Savings.	Average	Average
Increase return on investments.	Average	Average
Increase in productivity.	Low	Average
Improve financial liquidity.	Average	Average
Others, please mention and explain.	-	-

Waste Recycling Strategies

For this part, the researcher will describe the waste recycling strategies for environment, social, and economy improvement in plastic and ceramic local industries. From the interview session, there are some waste recycling strategies given by each of the industry regarding their waste management method in Table 4.

<**Table. 4**> Future Recycling Strategies for Plastic and Ceramic Industry

No	Strategies	Plastic	Ceramic
a)	Waste can be used as raw material in the waste recycling process?	Agree	Agree
b)	Using waste materials is less expensive than using fresh raw materials.	Agree	Agree
c)	Energy costs will reduce if recycled waste materials.	Disagree	Agree
d)	Plastic waste recycling system are not logistically complex than conventional waste processing systems.	Agree	Agree
e)	Lower waste management cost.	Agree	Agree
f)	Raw plastic that need little oil or gas or other resources.	Agree	Agree
g)	Manufacturer must improve eco-design and recycled plastic use which only products that are designed with recycling can be recycled in a cost-effective manner.	Agree	Agree
h)	Products that use multi-layer plastics, such as various polymers or fabrics, recycling not to be complicated.	Disagree	Disagree
i)	Polymers also can be recycled in practice if they exist in sufficient amounts in plastic waste streams.	Agree	Agree
j)	Recycled resins are not hampered by odour or colour issues.	Agree	Agree
k)	Able to face technological challenges of increasing the amount of recycled content in the new products.	Agree	Disagree
l)	Artificial intelligence can be used by some of the most recent sorting robots to develop their ability to identify waste.	Agree	Agree
m)	Scaling effect that can be accomplished by centralizing sorting and processing.	Agree	Agree
n)	Areas of selection, sorting, and distribution, efficiency improvements are possible.	Agree	Agree
o)	Pollution level should be monitored during the waste recycling process?	Agree	Agree
p)	Efficiency of the process in waste recycling is important?	Agree	Agree
q)	Energy conservation is important during the process?	Agree	Agree

All interviewees are responded to the research questions created very well and the researcher can make some analysis based on their different perspectives in answering them. Overall, having a good management for producing the products is not enough but the industry should manage too for the waste disposal that are produced from the productions of the items. This can be called as the responsibility for each company to overcome the problems so that in future, there might be no issues occur related to the company as well as not giving bad effects towards the environment and social.

CONCLUSION

Plastics and ceramics industries have tried their best to manage waste. The impact of these activities is positive for the environment, economy, and social of their companies even though it is not much. They have certain challenges, especially the high cost of waste recycling process. They agree with the recycling processes to improve the current waste management activities and give expectations that the impact on the environment, economy, and social will be more positive. They also agree with the proposed future recycling strategies for plastic and ceramic industry as follows:

Waste can be used as raw material in the waste recycling process
Using waste materials is less expensive than using fresh raw materials.
Plastic or ceramic waste recycling system are not logistically complex than conventional waste processing systems.
Lower waste management cost.
Raw plastic or ceramic that need little oil or gas or other resources.
Manufacturer must improve eco-design and recycled plastic or ceramic use which only products that are designed with recycling can be recycled in a cost-effective manner.
Polymers also can be recycled in practice if they exist in sufficient amounts in plastic or ceramic waste streams.
Recycled resins are not hampered by odour or colour issues.
Artificial intelligence can be used by some of the most recent sorting robots to develop their ability to identify waste.
Scaling effect that can be accomplished by centralizing sorting and processing.
Areas of selection, sorting, and distribution, efficiency improvements are possible.
Pollution level should be monitored during the waste recycling process.
Efficiency of the process in waste recycling is important.
Energy conservation is important during the process.

Hence, it is possible to cycle these wastes to create other new beneficial product of green concrete as proposed by this research program. The contribution of this research is it opens ways to use waste to create other beneficial products which is green concrete for better constructions and buildings.

ACKNOWLEDGEMENT

Researchers would like to thank the Faculty of Technology Management and Technopreneurship, Faculty of Mechanical and Manufacturing Engineering Technology, and Universiti Teknikal Malaysia Melaka under grants PJP/2020/FPTT/PP/S01779 for facilitating and funding this project. Researchers also would like to thanks to San Miguel & Golden Clay.

REFERENCES

Abdel-Shafy, H. I., & Mansour, M. S. M. (2018). Solid waste issue: Sources, composition, disposal, recycling, and valorization. *Egyptian Journal of Petroleum*, *27*(4), 1275–1290. https://doi.org/10.1016/j.ejpe.2018.07.003

Awasthi, A. K., Shivashankar, M., & Majumder, S. (2017). Plastic solid waste utilization technologies: A Review. *IOP Conference Series: Materials Science and Engineering*, *263*(2). https://doi.org/10.1088/1757-899X/263/2/022024

Awoyera, P. O., & Adesina, A. (2020). Plastic wastes to construction products: Status, limitations and future perspective. *Case Studies in Construction Materials*, *12*, e00330. https://doi.org/10.1016/j.cscm.2020.e00330

Awoyera, Paul O., Ndambuki, J. M., Akinmusuru, J. O., & Omole, D. O. (2018). Characterization of ceramic waste aggregate concrete. *HBRC Journal*, *14*(3), 282–287. https://doi.org/10.1016/j.hbrcj.2016.11.003

Bakri, M.H, Dabas.N, Ismail, S. and Baharom, A.H. Islamic Student Financing Back Securitization in Malaysia. Advanced Science Letters, Vol 23 No 9,2017,pp 8090-8093.

Barclay, S. (2018). *Semi-Structured Interviews*. *March*, 1–3.

Bhattacharya, R. R. N. S., Chandrasekhar, K., Deepthi, M. V, Roy, P., & Khan, A. (2018). Challenges and Opportunities: Plastic Waste Management in India. *The Energy and Resources Institute*, *24*(2), 3–7.

Characteristics of waste streams and requirements for recycling processes Executive summary. (2020).

Cropley, A. (2019). Qualitative research methods: A practice-oriented introduction for students of psychology and education. *University of Hamburg*, *24*(4), 354, 356. https://doi.org/10.13140/RG.2.1.3095.6888

d'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. *Field Actions Science Reports. The Journal of Field Actions*, *Special Issue 19*, 12–21.

DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: A balance of relationship and rigour. *Family Medicine and Community Health*, *7*(2), 1–8. https://doi.org/10.1136/fmch-2018-000057

Elmahyarv, M., Amin, S., Abadir, M., & Sadck, M. (2018). Simultaneous reuse of three types of wastes in the preparation of eco friendly ceramic floor tiles. *23rd International Congress of Chemical and Process Engineering, CHISA 2018 and 21st Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction, PRES 2018*, *2*(7), 862.

Faique, F.A., Ismail, S., Bakri, M.H., Idris, N.H., Yazid, Z.A., Daud, S., Taib, N.M. (2017) Testing the financial attitude as a mediator for the relationship between financial self-efficacy with financial behavior Advanced Science Letters, 23 (8), pp. 8009-8012.

Fernandez, V. (2020). Fundamentals of Research Methodology. In *Fundamentals of Research Methodology*. https://doi.org/10.3926/oss.38em

Hahladakis, J. N., Iacovidou, E., & Gerassimidou, S. (2020). Plastic waste in a circular economy. *Plastic Waste and Recycling*, *March*, 481–512. https://doi.org/10.1016/b978-0-12-817880-5.00019-0

Hojnik, J., Ruzzier, M., & Ruzzier, M. K. (2019). Transition towards sustainability: Adoption of eco-products among consumers. *Sustainability (Switzerland)*, *11*(16). https://doi.org/10.3390/su11164308

Husband, G. (2020). Ethical data collection and recognizing the impact of semi-structured interviews on research respondents. *Education Sciences*, *10*(8), 1–12.

https://doi.org/10.3390/educsci10080206

Janmaimool, P. (2017). Application of protection motivation theory to investigate sustainable waste management behaviors. *Sustainability (Switzerland)*, *9*(7), 1–16. https://doi.org/10.3390/su9071079

Jereme et al. (2015). 済無No Title No Title. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Kim, S., Jeong, S.-H., & Hwang, Y. (2013). Predictors of Pro-Environmental Behaviors of American and Korean Students. Science Communication, 35(2), 168â€"188. https://doi.org/10.1177/1075547012441692

Kong, S. C., Wong, T. L., Yang, M., Chow, C. F., & Tse, K. H. (2017). Emerging practices in scholarship of learning and teaching in a digital era. *Emerging Practices in Scholarship of Learning and Teaching in a Digital Era*, *February*, 1–373. https://doi.org/10.1007/978-981-10-3344-5

Kwesiga, D. (2018). Strategies for managing plastic waste from construction and manufacturing projects. *Rwanda Journal of Engineering, Science, Technology and Environment*, *1*(1). https://doi.org/10.4314/rjeste.v1i1.9s

Margaret C. Harrell; Melissa A. Bradley. (2019). Data Collection Methods Semi-Structured Interviews and Focus Groups. In *Distribution*. https://doi.org/978-0-8330-4889-9

Marquit, J. D. (2008). Threat Perception as a Determinant of Pro- Environmental Behaviors : Public Involvement in Air Pollution Abatement in Cache Valley , Utah. Perception.

Mohajan, H., & Mohajan, H. K. (2018). Munich Personal RePEc Archive Qualitative Research Methodology in Social Sciences and Related Subjects Qualitative Research Methodology in Social Sciences and Related Subjects. *Journal of Economic Development, Environment and People*, *7*(85654), 1.

Mwanza, B. G., Mbohwa, C., & Telukdarie, A. (2018). Strategies for the Recovery and Recycling of Plastic Solid Waste (PSW): A Focus on Plastic Manufacturing Companies. *Procedia Manufacturing*, *21*(2017), 686–693. https://doi.org/10.1016/j.promfg.2018.02.172

Saadi Nurzalikha, Ismail Zulhabri, & Alias Zarina. (2016). A review of construction waste management and initiatives in malaysia. *Journal of Sustainability Science and Management*, *11*(2), 101–114.

Scientific and Technical Advisory Panel. (2019). *Theory of Change Primer A STAP document*. *December*.

Sharma, S., & Mallubhotla, S. (2019). Plastic Waste Management Practices. *Zero Waste*, *March*, 105–113. https://doi.org/10.1201/9780429059247-7

Tadesse, H. T. (2020). Investigation on the appropriateness of ceramic waste materials at hawassa ceramics factory as partial replacement of conventional aggregate in concrete making. *IOP Conference Series: Materials Science and Engineering*, *993*(1). https://doi.org/10.1088/1757-899X/993/1/012123

UNIDO. (2019). Development of recycling industries within the UNIDO circular economy approach. *United Nations Industrial Development Organization*, 32. https://www.unido.org/sites/default/files/files/2019-07/Development of recycling industries within the UNIDO circular economy approach.pdf

Vázquez, F. Q., Garci'a-Ten, F. J., Dosda, T. R., Albalat, C. G., Villalba, D. C., Zaera, V., & Mestre, C. S. (2017). LIFECERAM: Zero waste in ceramic tiles manufacture. *CFI Ceramic Forum International*, *94*(1–2), E41–E50.