

ASSIGNMENT 1
Research Proposal:
Feasibility of Recycled Plastic in Road construction



M5X01771

RESEARCH METHODS: Assignment 1

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Research Methods Assignment 1: Research proposal

Infrastructure: *The feasibility of reclaimed plastic road construction.*

Introduction

This intended purpose of this research proposal is to justify further evaluation and investigation into the subject topic;

The feasibility of reclaimed plastic in road construction.

Literature Review

A plethora of scholars and authors theorise that plastic waste is currently at crisis point. Oceans are heavily affected by even though efforts are being made to remove such waste from the sea, the disposal methods once collected are limited.

A solution to the disposal of this waste is in the production of part Geopolymer Asphalt and alternatively, recycled modular road segments which are made using entirely recycled plastic. Current reports indicates that the benefits of these method will not only reduce unrecycled waste and the harmful gases released via incineration but significantly lower co2 emissions in the production process involved with traditional asphalt road surfaces.

Background: Problems ...***Road Infrastructure***

Noort (1996) avers that asphalt roads were first introduced in Nottingham in the 1840s and used a coal tar binder. This was produced without the correct research and testing of the products lifecycle and highlights the inadequacies in ascertaining the final costs involved with using it in large scale projects. A result of the industrially naïve scientific methods of the period. Furthermore, adding that although asphalt can be recycled to produce new surfaces, the co2 emissions involved are very high.

Carbon Trust (2017) and Nicholls et al (2013) both affirm this statement and express that in the UK alone, approximately 25 million tonnes of asphalt are produced each year. Additionally, expanding on this to claim to assert that when asphalt is combined with the embedded co2 of aggregate and bitumen, the result is 40kg / Co2 / ton ne
“The total UK carbon footprint associated with asphalt manufacture is estimated at

786,000 tonnes of CO₂/year which is the equivalent to 5,000 km driven by a million average family cars”.

Current Methods in infrastructure

Butcher (2016) states that CO₂ production is not the only problem when analysing existing methods of recycling and repair of infrastructure. The problems involved with UK potholes alone will take 14 years and 12 Billion pounds to repair. Additionally, summarising that this projection is forecast by assuming that no other damage is incurred to road surfaces. ARRA (2006) proclaim that the current main methods of recycling are:

- Cold Planing – removing a top layer and resurfacing
- Hot recycling – This process is the most popular and involves either fresh or reworked hot reclaimed pavements or roads.
- Full depth reclamation – The existing road surface is treated to produce a stable base for new to be laid.

Kreijger (2013) confirms that these methods are used but does not agree with the recommended rehabilitation processes. Moreover, insisting that there are many problems which are not addressed during remanufacture. For example, crushed reclaimed materials have a very high absorption rate and require higher amounts of bitumen to allow a stable bond for laying. Other factors include external influences such as contamination, e.g road salts.

Ocean's

Rae (2009) Proffers that plastic waste is at a crisis of epic proportion, insisting that if no more plastic entered the ocean, it would take over 1000 years for the remaining excess to degrade naturally "Our oceans contain millions of tons of plastic".

Furthermore, stating that most plastics are cheaper to produce from scratch when compared to the process involved with recycling used materials. This is further accredited by Karl et al (2013) and Derraik (2009) who validate this statistic, further elaborating on the effects to the oceans ecology and the contribution to the contamination of one of the world's main food supplies for numerous species.

Current Methods of plastic waste disposal

Whilst previously cited, the predicament that we are facing as a planet are heavily documented, although a definitive conclusion to solve the problem is still a work in progress. Goodship (2007) states that currently there are 4 main options to recycle plastic:

- Re-use – this is a rarely used option as most plastics are discarded after use.
- Mechanical – Ground up to make new products.
- Feedstock – The plastic is reverted to oil / hydrocarbon.
- Incineration – Waste is burned.

O'Connor (2017) affirms that even though these methods are in place, they are inadequate to deal with new manufacture. Moreover, producing evidence to suggest that in the region of 86% of yearly waste through plastic production is neglected. This waste enters oceans, is sent to landfill sites or stock piled for recycling "The world recycles just 14% of the plastic packaging it uses. Even worse: 8m tons of plastic, much of it packaging, ends up in the oceans each year".

Case studies: Plastic Roads

Macrebur (2017) States that the initial concept of using plastic on roads is thought to of been applied embryonically in India. Citizens in certain areas had tried to find a solution to fill pot holes by filling it with plastic and setting it alight to melt into an improvised filler repair.

There are currently 2 confirmed methods of implementing mass waste reduction in the construction or repair of road surfaces:

Bitumen Replacement

Macrebur claim to be the sole provider of excess plastic bitumen replacing additives in the world and have successfully implemented this technology on trial roads in the UK. Additionally, profess that plastic roads are possible by the means of using 100% recycled materials. Specifying that it possess superior qualities traditional bitumen solutions that require modified polymers to produce the correct mixture requirements.

“ Below are some of the structural benefits of modifying asphalt with MacRebur® products.

- Huge increase in tensile strength
- Improved rheology
- Improved cohesion and adhesion
- Improved fuel resistance
- Vastly increases asphalts resistance to character deformation and rutting
- Increased resistance to cracking and fatigue failures
- Increases lifespan of road ”

Although this method of dealing with the problem of excess waste states that the asphalt additive comprises of 100% recycled materials and claims various

enhancements. Via inspection of the binding formulation used, it states that the highest concentration of plastic implemented as a direct replacement for bitumen is 6% in total. This indicates that 94% of the compound road structure remains binded via bitumen.

“The Existing Asphalt was removed and replaced with 60mm of AC 20 HDM + MR6 additive, and 40 mm of HRA - *MR6 Additive to replace 6% of the bitumen content*” (Macrubar technical data, 2017)

Volker Wessel's Plastic Road Project

Richards (2017) proffers that Dutch company Volker Wessels Plastic Road Project is an innovative technology which is in its very early stages of production. Furthermore, stating that the concept involves the production of pre-fabricated hollow modular road sections.

Total (2017) proclaim that a co-operation agreement has been signed between 3 companies in respect to the development of the plastic road, which include themselves, Wavin and Volker Wessel.

Volker Wessel (2017) aver that the production methods use 100% recycled materials from start to finish and do not require any other materials which will incur further CO2 production to be factored into its overall emission output “Plastic Road is produced from 100% recycled plastic: plastic that is currently being incinerated”.

Total (2017) proclaim that each road segment is produced with a hollow inner core which is not only intended be used to house services such as water pipes and electrical cables but also the ability to be used for water collection from the road service to prevent flooding.

Further adding, that each slab is completely circular and maintenance free. If a section is damaged, it is replaced with a new prefabricated module and the piece which is removed can then be shredded to make a new piece for future replacements when required.

PlasticRoads.eu (2017) testify that the segments are superior when contrasted to traditional road construction:

- Lifecycle – expected to last 2 to 3 times longer.
- Installation times are reduced by 70%
- Weight - 4 times lighter
- 100% Recycleable

Methods of research: Are plastic roads feasible?

To satisfy the information required, it is apparent that a Methodological Triangulation method of research will be required to provide the most comprehensive statistical classification possible. This will include obtaining data that is qualitative and quantitative in its approach.

There are many questions which require transparency from the respected bodies involved with the process of these ventures. Main data types can be divided into specific categories to determine the feasibility of these methods:

- ***Perception / Marketability***

A quantitative approach will be beneficial when collecting data with regards to public perception of the technologies that are presented. This method can be justified by the fact that a very high percentage of the population use infrastructure daily. An anonymous questionnaire will provide a wide pool of data for analysis and is not discriminatory with regards to personal circumstance. It is impossible to predict if all feedback will be returned within a specified timescale, this can be offset by making the study open to a higher number of people and will, in theory, lead to a higher number of questionnaires being returned. Some example enquiries are:

Are people aware of the problems which currently exist?

Are people currently satisfied with the methods that are being implemented with regards to recycling and infrastructure?

Analysis of public and industry perception on the systems which are being developed for employment.

Are these methods perceived as a suitable solution to appease current problems?

Will the information presented change views on how the public recycle their waste?

- ***Technical Viability***

With regards to the technical viability, a much more detailed knowledge of the subject area is required. A qualitative approach to obtaining this data is beneficial and a necessity to provide statistics which will hold value when analysed. A logical step to attain this data is to request statistical information from the manufacturers and installers of the product once the planned practical implementation “Plastic Roads Project Rotterdam” for example have been completed. Further valuable data will be obtained through interviews with representatives of the 4 companies currently involved in the use of plastic roads:

- Macruber
- Total
- Volker Wessel
- Wavin

Areas of interest which will be beneficial for this study will include:

Have the initial practical projects met expectations?

Do the systems meet or exceed the projected performance requirements in comparison to current technology?

Do current technologies allow for a simple transition from current methods of construction?

Application: are current industry labour skills easily transferable to execute the proposed system?

Availability of the product in required country or area. E.g. is the manufacturing process transferable?

Are the lifecycle estimations of the product backed up by sound scientific research?

Are local government standards achieved?

- ***Commercial sustainability***

Commercial Sustainability is at the forefront of any new method of construction. If the system cannot be implemented with the incentive of profitability, it will be very difficult to implement.

A qualitative approach through interviews with current authorities who have applied the methods to a finished project. Cumbria County Council and forthcoming Rotterdam City Government are 2 such bodies who are evidently the source with the most information as they have publically stated their intentions to further use the techniques available. "Our industry does have a significant environmental impact - we use a lot of oil-based products and aggregate that comes out of quarries. So any opportunity that we get to try and mitigate some of that has to be of benefit." (Steven Hall, 2017).

Questions of interest in this topic will be:

Is it a sustainable business model?

Will industry adopt these methods?

Will local council / government bodies approve the standardisation of its use?

Result Analysis

The results will be impartially analysed and will be presented in tabled data format.

Relationships between quantitative and qualitative data, if any, will be highlighted and investigated further to produce a reliable report on the feasibility of reclaimed plastic in road construction.

Conclusion

The research and data pool available for both methods of plastic road, present a challenging topic area as they are currently limited. It is evident not only in construction, that innovative technologies are highly guarded to avoid plagiarism until pending patents are granted in the respective countries for which it has been applied. This clandestineness in this field is set to change imminently, enhanced application of both methods in various confirmed projects set to commence at the beginning of 2018. E.g. The plastic road project: Rotterdam 2018 and extensions to the Cumbrian roadwork systems. This research will be difficult but is evidently obtainable through the cooperation of the companies who hold the specific information required.

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