Mechanical Behavior of Concrete Filled with Melamine-Formaldehyde Plastic Waste

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To My
Parents

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ABSTRACT

Solid waste disposal in Palestine is a serious problem and constitutes a major part of all other kinds of waste. In the present work we focus on one major kind of plastic waste, that is the cross-linked Melamine-Formaldehyde (MF). It is a thermoset polymer that cannot be recycled or reprocessed.

MF waste was collected and milled to various particle sizes and was added into mortar and concrete as a filler and a substituent of various quantities of local Palestinian sand at a volume percent of 10, 20, 30, 40, 50, 60.

The mechanical properties, compression and tensile strength of this new composite material were evaluated. Different variables were taken into consideration, water to cement ratio, percent of MF in the composite, and its particle size.

The results indicated that there is an enhancement in the compressive strength of both concrete and mortar as the % of MF was increased up to 30% in the composite material, so it is reported in this study that a new light weight concrete and mortar was produced with improved compression strength.

Having known that MF exhibit a high decomposition temperature, further study was carried out to evaluate the insulation characteristics of this new composite material, the results obtained showed that we also achieved improved insulation properties.

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List of Abbreviations

ACF: Average compressive force.

ACS: Average compressive strength.

C: Conductance.

cal: Calorie.

C°: Degrees Celsius.

EPA: Environment Protection Agency

Ft: Foot

HDPE: High-density polyethylene.

Ib_f: Pound force.

K: Conductivity.

K°: Degrees Kelvin.

LDPE: Low-density polyethylene.

MF: Melamine-Formaldehyde

mm: Millimeter.

Mpa: Megapascal.

N: Newton.

PC: Polymer concrete.

PIC: Polymer-impregnated concrete.

PMC: Polymer modified concrete.

PP: polypropylene

psi: Pound per square inch.

PVC: polyvinyl chloride.

R: Specific resistance.

S: Second.

SBR: Styrene Butadiene rubber.

UF: Urea- Formaldehyde

VFA: Very fine aggregates.

W: Watt.

Chapter One

Introduction

1.1 Introduction:

Solid waste forms most of the waste arising from human and animal activities, that are normally, solid and that are discarded as useless or unwanted [1].

It encompasses the heterogeneous mass of throw away from the urban community as well as the more homogeneous accumulation of agricultural, industrial and mineral waste. In an urban setting the accumulation of waste is a direct consequence of life. The solid waste problem is very serious, its hazard affect public health, especially the liquid from dumps and poorly engineered landfills. It contaminates surface water and ground water. In mining areas the liquid leached from waste dumps may contain toxic elements such as copper, arsenic, uranium, and may contaminate water supplies.

The burning of solid waste causes air pollution, and that is also very dangerous to the environment and to human health.

The Environment Protection Agency (EPA) in the United State of America estimates that solid waste increases at a rate of 4.5 percent/year [1]. If major efforts at resource recovery and recycling were to be effective the rate of increase might be as low as 2.5 percent.

The EPA has developed three different growth rates of solid waste generation between the years (1980 – to 1990) as given in table 1-1 [1].

Table 1-1 Growth rate of solid waste generation in the USA.

Assumed annual compound growth percentage	Million tons			
	1980	1985	1990	2000*
2.5 (low)	155	175	200	245
3.5 (medium)	170	200	230	290
4.5 (high)	180	230	290	400

* Estimated

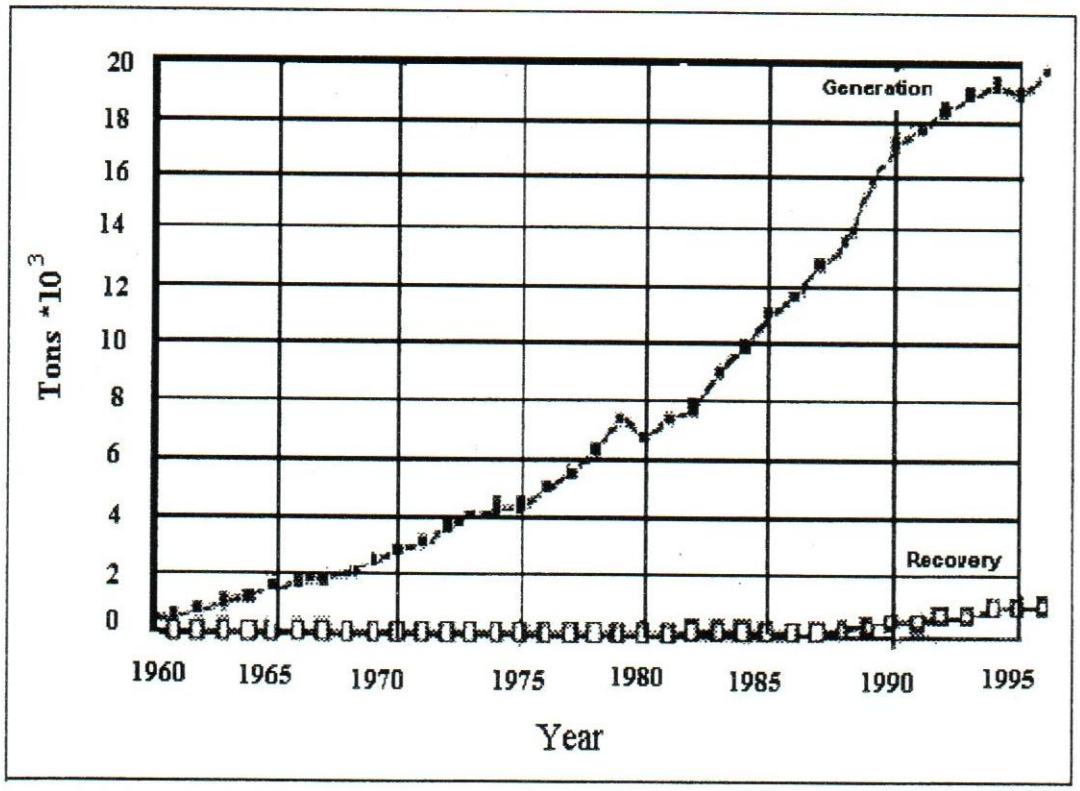
The best way to reduce the amount of solid waste that must be disposed of is to limit the consumption of raw materials, and increase the rate of recovery, and the reuse of waste material, this will achieve the following goals:

- Protection of human health and environment from the hazards posed by waste.

- Conservation of energy and natural resources.
- Reduction or elimination of the hazardous waste as possible.

Plastics, rubbers, and textiles account for 20% by weight and 41% by volume of the total municipal solid waste in the United State. However only Six per cent of plastics, rubbers, and textiles were recovered for recycling [2].

Figure 1-1 Plastic waste generation and recovery from (1960-1995) in the United States of America [2].



1.2 Polymer waste.

Polymeric materials are used practically in all areas of daily life. Their processing and fabrication are major worldwide industries.

The biggest groups of polymeric materials are plastics. It accounts for over 78 % of the production, while synthetic fibers account for 14 %, and elastomers for 7.4% [3].

Polymers can be divided into two major types based on their thermal behavior:

A- Thermoplastics: these can be heat- softened in order to process and can be used again, such as High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Poly Propylene (PP), Poly Vinyl Chloride (PVC) and Polyester.