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Reducing the Negative Effects of Dust Storms using Solar Energy to Recycle Plastic Waste

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Abstract: ***A sandstorm is characterized as one that whips up extraordinary loads of sand into the air, forming a dense cloud above the ground in the process. While most of the sand will rise higher than 50 cm, some sand particles can even ascend to the height of 2 meters. According to Wikipedia, the average diameter of the particles carried by such dust storm winds will vary between 0.15 and 0.30 mm. Wind speeds such during sandstorms have been recorded at up to 16 km per hour and more, while most storms continue to blow for between three hours to five hours. The dust unleashed from sandstorms continues to pose severe environmental concerns in certain Arab and Middle East countries, causing great hardships to its citizens in the form of lost income and widespread infrastructure damage. Perhaps more importantly, when it comes to measuring the effects on people's health, it has been well documented that sandstorms have, in many cases, led to both the death and destruction of livestock, crops and even human beings. Based on the above factors, scientific researchers continue to work tirelessly to confront sandstorms in an effort to both prevent and alleviate this dangerous natural phenomenon. This particular study will look to establish a low-cost system of erecting plastic trees built from solar energy and recycled plastic waste in order to reduce the risks of sandstorms.***

Index Terms: ***Middle East countries, recycled plastic, sandstorms, solar energy.***

I. INTRODUCTION

Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. **Do not change the font sizes or line spacing to squeeze more text into a limited number of pages.** Use italics for emphasis; do not underline.

When sandstorms strike, the strong blowing winds that accompany them tend to extract large amounts of dust and soft sand away from the ground, carrying these particles long distances and leaving a string of nasty environmental effects in its path. In fact, studies have shown that the transfer and displacement of this dust over long distances adversely affects the more vital chemical cycles of soil, atmosphere and seas, upsetting what is often referred to as equilibrium radiation. In fact, by shading the Earth from the sun's radiation, dust aerosols actually block natural sunlight in much the same way that a rain cloud would [1]–[3].

The inevitable result is that human health is ultimately affected. In fact, a study conducted by the Pakistan Journal of Medical Science found that exposure to sandstorms can lead to coughs and wheezing, eye irritation, headaches, body aches and sleep and psychological disturbances, while longer term effects of exposure to tiny dust particles have been proven to affect the respiratory system and lead to chronic diseases such as asthma [4]. Several of these very effects have been highlighted in Figures 1 and 2, displayed below.

Fig. 1. The imposing dust clouds unleashed by sandstorms.

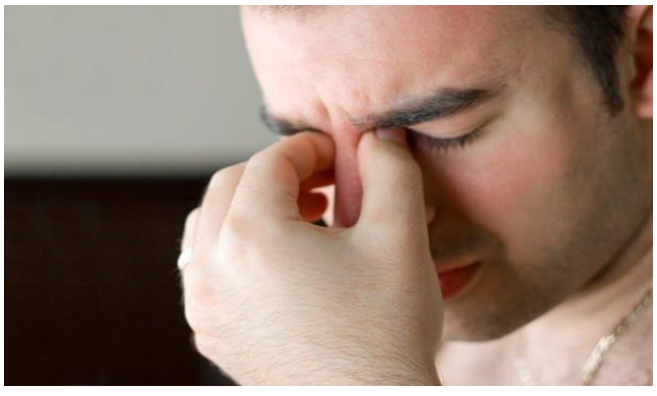

Fig. 2. The adverse health effects of sandstorms.

Longer-term health impacts notwithstanding, sandstorms can also have huge economic impacts and result in the immediate loss of life.

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On May 5, 1993, sandstorms raging over 1.1 million square kilometers in the Republic of China resulted in 85 deaths and 246 injuries; destroyed 4412 houses and 373,000 hectares of crops and wiped out nearly 120,000 cattle. The direct economic cost to all this destruction was estimated at roughly 66 million dollars. According to the Regional Master Plan for the prevention and control of Dust and Sandstorms in Northeast Asia, the sandstorms that hit Mongolia in April 2002 were even stronger, forcing the international airport in Ulan Bator to shut for three days. During this same storm, the Republic of Korea also closed schools and canceled more than 40 departures from Gimpo Airport in Seoul. Satellite images taken in the wake of this monstrous sandstorm reveal that dust from this particular storm actually reached North America from across the entire expanse of the Pacific Ocean [5].

In addition, sandstorms also threaten the safety of transportation and other critical infrastructure. In certain Middle Eastern countries, they have damaged both the industrial and oil installations buildings by depositing a layer of sand particles on their mechanical and electronic devices, all of which can lead to their eventual failures. In addition, some regions and cities in Saudi Arabia have endured sandstorms accompanied by low visibility levels, in some cases less than 100 meters. Perhaps most notably, the sandstorm and accompanying dust cloud that swept across both Jeddah in April 2006 and in regions of Mecca and Medina in February 2006 storm led to the suspension of all air, sea and land traffic [5], [6].

Sandstorms also tend to cause sand creep that leave destructive sediment deposits on agricultural areas, leaving mostly barren sand dunes incapable of agricultural production in their wake. The dust storms that tend to accompany such storms also unleash particles of sand that damage tree branches and leads to a general stunting in the growth of plants. More often than not, it is the sheer ferocity and unrelenting nature of the winds that cause the most damage. According to a study entitles "Properties and the amount of soil losing by wind drift in the Riyadh region", in January, stations located in Riyadh, Saudi Arabia recorded repeating medium winds from the north that were more than 200 times normal, as well as repeating static winds that exceeded 100 times the normal. In addition, the medium-speed winds in that same period continued for 28 days, the strong winds continued for 66 days and the very strong winds continued for 28 days [7].

Given all its destructive potential, it is important to bear in mind that the emergence of sandstorms requires two main conditions, namely the presence of constant wind as well as a land surface that is both dry and loose. A dessert obviously comes to mind. Therefore, understanding and possibly predicting the occurrence of these sandy hurricanes is based on studying weather conditions and the characteristics of the soil surface in any given country.

II. The Approach to this Study

This study proposes the creation of a row of uniquely shaped industrial trees that are similar in shape to broad-leaved banana trees. Arranged in two trunks per row from the lowest point to the highest point on the right, they would be left unpacked over the designated area required to be protected. These 'trees' would be manufactured entirely from recycled plastic products using clean solar collectors; effectively, solar ovens composed of spherical mirrors and Fresnel lenses that would melt the plastic into the shapes displayed in Figures 3, 4 and 5 below:

Fig. 3. A Series of Plastic Trees.

Fig. 4. Using spherical mirrors and Fresnel lenses to melt plastic.

Fig. 5. Harnessing the power of solar energy.

The manufacturing of such trees would be conducted entirely from the recycled plastic waste. The advantage of plastic trees is their ability to move flexibly with the wind without breaking. Obviously, securing the raw material would not be an issue. The required plastic is already used in packaging, aircraft parts, automobiles, electronics and sports equipment due to its light weight, formability, chemical resistance and both high and low durability. Moreover, plastic is inherently malleable and wouldn't require much energy to melt.

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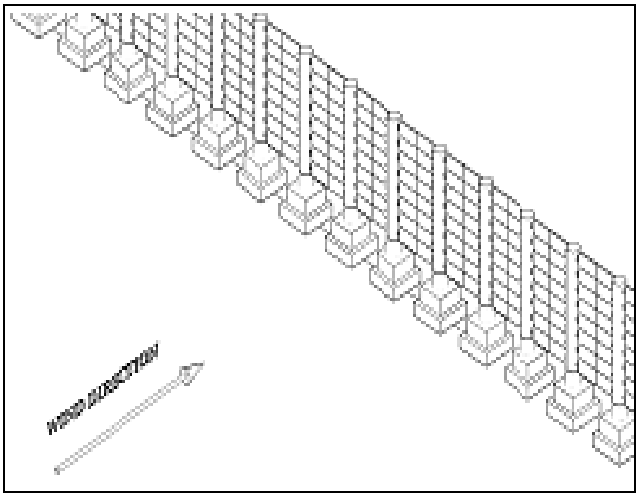
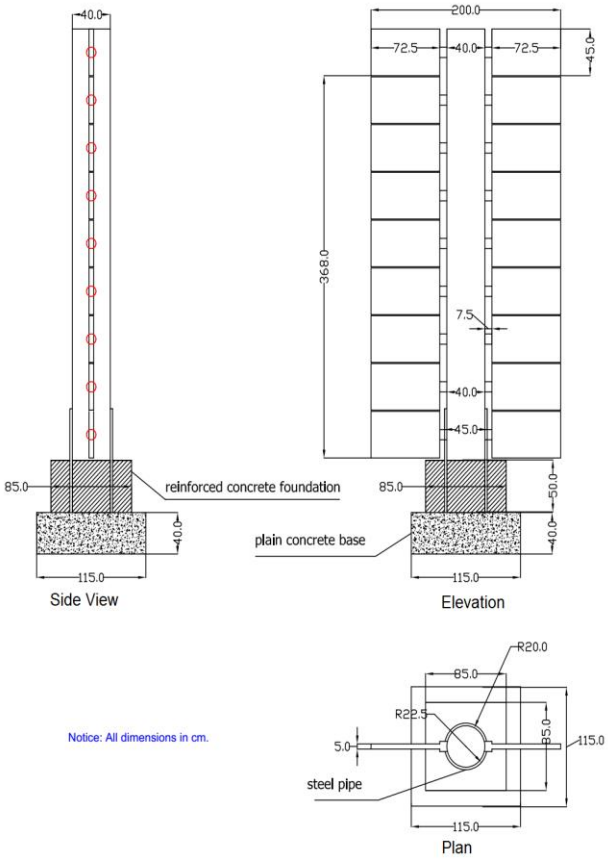
Because plastic does not represent such an important raw material in many countries, it is often neglected and dumped in landfills with the rest of our 'garbage'. Educating citizens about the importance of such plastic packaging, providing them with private dumps and informing those responsible for garbage collection as to the importance of separating plastic materials from other garbage whenever possible would be paramount to the program's success.

Once the source of raw material is secure, choosing the actual form of the plastic tree will be crucial to its storm-resistance, as is displayed in Drawings 1 and 2. Keeping this in mind, designing the tree top spirals and equipping these with an onyx riding when needed is something that can be considered in the future.



Drawing 1



Drawing 2

III. CALCULATIONS

Using both the COSMOS simulation and SAP program, the researchers determined the best shape (as displayed in Drawings 1 and 2) given the dimensions of the tree. In this case, the plain concrete foundation, reinforced concrete foundation and steel cylinder are welded directly to the reinforced concrete foundation. A combination of high and medium density polyethylene is the component present in plastic bottles with a density of 0.95 *ton/m*^{3} [8], plain concrete density is 2.2 *ton/m*^{3}, reinforced concrete density is 2.5 *ton/m*^{3} and the steel cylinder density is 7.75 *ton/m*^{3}.

The weights of all materials were measured. (See table I)

Table I

Element	Member	Numbers	Volume of Each Member (m^3)	Volume of all Members (m^3)	Total volume of Material (m^3)	Total Weight (ton)
tree	tree trunk	1	0.52	0.52	0.83	0.79
	Tree stalk	18	0.0006	0.01		
	Tree leaf	18	0.016	0.3		
Steel cylinder		1	0.015	0.015	0.015	0.11
Plain concrete		1	0.36	0.36	0.36	0.9
Reinforced concrete		1	0.53	0.53	0.53	1.32

IV. ESTIMATED COST

Using the values in the table above, it has been estimated that one worker can collect roughly 100 kg of plastic bottles in five working days. If we then calculate paying him $1000 per month, we will require roughly $300 per tree in addition to roughly $50 for the necessary manufacturing. At a steel price of $300 per ton, the price of the cylinder would work out to roughly $30, a plain concrete price of $70 per cubic meter and a reinforced concrete cost of $165. The total cost will therefore come out to roughly $615 per plastic trees.

Give that each tree covers roughly 2 meters, cover a distance of 1 kilometer would require roughly 500 trees at a cost of 307,500 $.

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V. CONCLUSIONS

Industrial trees are working as windbreaks and barrier to dust, helping to prevent large quantities of dust from reaching residential areas and reduce the health problems caused by the dust. The use of solar energy as a clean energy does not have bad effects caused by other energy sources on the environment. The cost to cover a village ten kilometers length of less than three millions dollars keep for a time period of not less than twenty years, for any village implementation of the project can be self-help,. Coverage of all directions is not required where the wind to any area does not be in more than two directions throughout the year.

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