Menofia STEM School 11TH Grade

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2021/2022

2ND Semester

Contents:

Present and Justify the Problem

Egypt Grand Challenges:

1. Recycle garbage and waste for economic and environmental purposes:

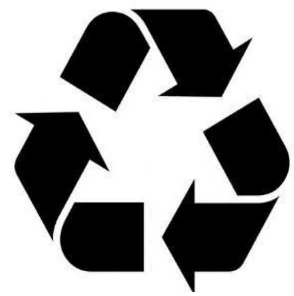


FIG 1

Recycling is well-known for its environmental benefits, which include resource conservation, energy conservation, and reductions in water and air pollution, including reductions in greenhouse gas generation, however, it also has significant economic benefits, many of which are often overlooked. Recycling is an important segment of the national and state economy, creates jobs, and saves money for generators of waste. The businesses, institutions, and local government entities highlighted in this report all understand that recycling makes both environmental sense and economic sense. Since the environmental benefits of recycling are more often the focus of much of the recycling discussion, this report will focus on the economic side of the recycling story and will demonstrate that recycling makes economic sense for New Jersey's commercial, institutional and governmental sectors.

In Egypt, waste and lack of proper management of it pose serious health and environmental problems

Generated Solid Waste in Egypt

Waste Type	2001	2006	2012
Municipal Solid Waste	14.5	17	21
Construction and Demolition Waste	3.5	4.6	4
Agricultural Waste	23.5	27.5	30
Industrial Waste	4.25	4.75	6
Medical Waste	0.12	0.15	0.28
Waterway Cleansing Waste	20	30	25
Total	67.12	86	89.28

for the country and its population. There have been some governmental attempts to better the system of waste management since the 1960s but those have not proven sufficient until now. In the last 10 years focus on this issue and solutions to it has increased both from the government and civil society. Some attempts at recycling are present, and growing in the country. But these are largely informal or private actors, and government initiatives are necessary to properly manage these systems and provide them with appropriate resources. In Egypt solid waste currently disposed of in dump sites has an indispensable potential for recycling, processing, or reuse. A report on recycled dry waste in 2013 covers plastics, paper, and metals as solid waste which is in the recycling process. However, a bulk of problems are created by not collecting wet organic waste forms which constitute 60 percent of the total waste in Egypt. Municipal waste flow differentiates between urban and rural areas, and approximations have been derived from per capita MSW (Municipal Solid Waste) generation rates by Governorate. National Municipal Solid Waste Strategy in June 2000 has included these estimates without explaining how these estimates were derived.

2. Increase the industrial and agricultural bases of Egypt:

In the 1920s, the Egyptian economy was characterized to be an agricultural economy as three-quarters of the Egyptian exports were raw cotton. As a result, industrial output was mainly cotton spinning and weaving; Although Egypt has begun industrialization long ago (1920's), it is still lagging far behind other countries that have begun the industrialization process much later than Egypt. The arising problem is that the Egyptian manufacturing sector is facing a deteriorating position in terms of trade, as the Egyptian economy faces competitive pressures from three fronts: First, countries within the MENA region that opened their economies early and took positive measures to

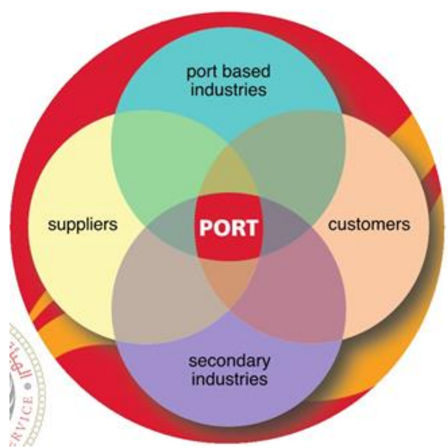


FIG 2

increase their competitiveness such as Tunisia and Morocco. Second, East Asian economies and European transition economies are characterized by having more efficient productive structures using skilled labor- and capital-intensive activities and hence produce higher value added and better-quality goods. Third, the large unskilled, labor abundant, low wage economies such as China, India, and Bangladesh that have been integrating rapidly into the global economy, exerting growing competitiveness pressures on countries exporting low skilled manufacturers such as Egypt. This paper deduces that the constraints to having a booming industrial sector are related to inefficient human resource development, technical constraints, legislative constraints, and economic constraints. Accordingly, the paper recommends having more investments in human development, building the capabilities of the public sector, more enhancements for the small industries, and managing the process of integration in the global economy. Egypt has traditionally resorted to high protective measures to promote industrialization, believing that it will help achieve self-sufficiency in strategic sectors and protect domestic employment. However, in recent years opinions have shifted, as evidence revealed that openness is the key to growth and development, as it was found that open economies grew at an average annual rate of 4.5 percent over the 1970s and 1980s, while closed economies grew at only 0.7 percent. Egypt, Argentina, and India were among the inward-oriented countries that started the 1970s with GDP growth rates that were higher than many outward-oriented countries at the time, then deteriorated and ended up worse off. As well as agriculture, Agriculture is a major component of the Egyptian economy, contributing 11.3 percent of the country's gross domestic product. The agricultural sector accounts for 28 percent of all jobs, and over 55 percent of employment in Upper Egypt is agriculture related. Egypt's agriculture sector is dominated by small farms using traditional practices that do not meet international standards. The Egyptian economy has

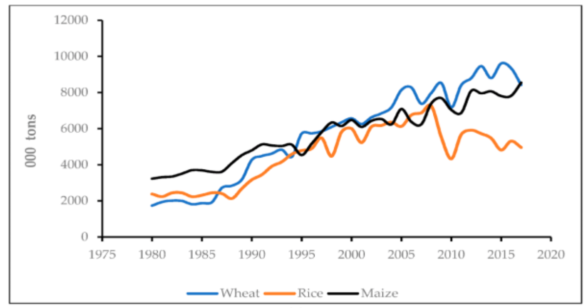


FIG 3

traditionally relied heavily on the agriculture sector as a source of growth and support for non-agricultural sectors. This central role was reinforced by the strong performance of the sector in the Sixties and Seventies. During the 1980s and 1990s, this dominance has declined but agriculture still accounts for a significant share of growth, exports, and employment. The share of agriculture GDP fell from 28.0 percent in 1960 to 17.5 percent in 1998. The share of agricultural employment declined substantially from 54.0 percent in 1960 to 30.8 percent in 1997. The total population of Egypt reached 67.2 million people of which 37.3 percent is the agricultural population in 1999.

3. Address and reduce pollution fouling our air, water, and soil.

Pollution: The introduction of dangerous items into the environment is referred to as pollution. These harmful materials are called pollutants. Pollutants can be natural, such as volcanic ash. They can also be caused by human activities, such as garbage or factory runoff. Pollutants wreak havoc on the environment, including the air, water, and land and The damage to everyone has its causes and effects.

Water pollution: type of pollution, is the contamination of water sources by substances that make the water unusable for drinking, cooking, cleaning, swimming, and other activities. Water is uniquely vulnerable to pollution. Known as a "universal solvent," water can dissolve more substances than any other liquid on earth. It's the reason we have Kool-Aid and brilliant blue waterfalls. It's also why water is so easily polluted. Toxic substances from farms, towns, and factories readily dissolve into and mix with it, causing water pollution. As water is an important element of human health, polluted water directly affects the human body. Water pollution causes various diseases like typhoid, cholera, hepatitis, cancer, etc. Water pollution damages the plants and aquatic animals present in the river by reducing the oxygen content of the water. Polluted water washes the essential nutrients which plants need out of

FIG 4

the soil and also leaves large amounts of aluminum in the soil, which can be harmful to plants.

Air pollution: Air pollution is a mixture of solid particles and gases in the air. Car emissions, chemicals from factories, dust, pollen, and mold spores may be suspended as particles. Ozone, a gas, is a major part of air pollution in cities. When ozone forms air pollution, it's also called smog. Any particle that gets picked up into the air or is formed from chemical reactions in the air can be an aerosol. Many aerosols enter the atmosphere when we burn fossil fuels—such as coal and petroleum—and wood. These particles can come from many sources, including car exhaust, factories, and even wildfires. Some of the particles and gases come directly from these sources, but others form through chemical reactions in the air. Air pollution has many bad effects on the health of people. It is the cause of many skins and respiratory disorders in human beings. Also, it causes heart disease too. Air pollution causes asthma, bronchitis, and many other diseases. Moreover, it increases the rate of aging of the lungs, decreases lung function, and damage cells in the respiratory system.


FIG 5

Land pollution: the deposition of solid or liquid waste materials on land or underground in a manner that can contaminate the soil and groundwater, threaten public health, and cause unsightly conditions and nuisances. Man's activities through urbanization, industrialization, mining, and exploration are at the forefront of global environmental pollution. Both developed and developing nations share this burden, though awareness and stricter laws in developed countries have contributed to a larger extent in protecting their environment. Despite the global attention towards pollution, the impact is still being felt due to its severe long-term consequences.

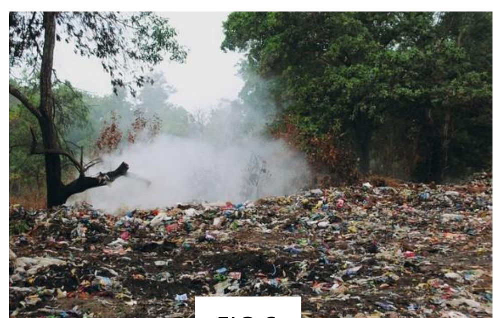


FIG 6

4. Improve the scientific and technological environment for all:

Advances in science and technology drive the evolution of the weather and climate information system. Scientific, operational, and, increasingly, business requirements determine what observations to make, how the information should be analyzed, and what products to create. The scientific understanding generated by developing and using these data and products, together with improvements in instrumentation and computation, lead to a new set of requirements. The new capabilities that emerge from this evolving system can change what the sectors are doing or want to do—sometimes dramatically—and thus directly affect public, private, and academic partnerships. Despite sharp declines in the telecommunications industry and Internet start-up companies, new technologies and products continue to be introduced at a rapid rate.1 Rapid technological change, intense competition, and the creation of new markets are expected to continue or even increase in the coming decade. This chapter reviews scientific and technological changes in the weather and climate information system that have the potential to affect partnerships. The committee focuses on how the evolution of technology might alter the balance between the sectors, rather than on specific technologies, which have been the subject of numerous reports. National Academies of Sciences, Engineering, and Medicine. 2003. Fair Weather: Effective Partnership in Weather and Climate Services. Given the breadth of digitalization's influence and the available evidence, some perspective is needed. Historically, the development of science and technology has been intertwined. Innovation in measurement tools provided a means to improve scientific understanding of nature, and this knowledge also turned out to be essential for innovation. Each wave of widespread technological development has

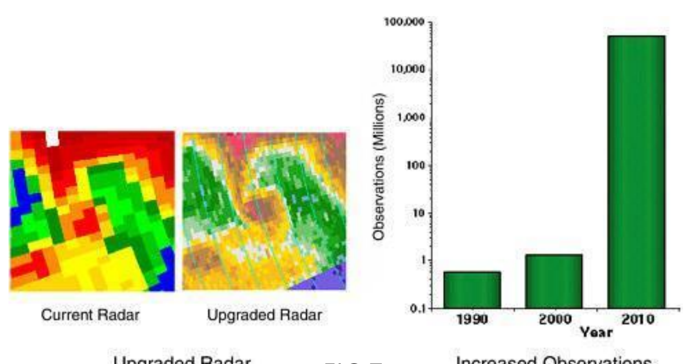


FIG 7

raised the question of what makes it truly distinctive and unique and how it might affect science and innovation (Furman, 2016). For the current wave of digitalization, several core questions emerge about the distinctiveness of new digital technology. What does it enable that was previously impossible or prohibitively expensive? In addition, how will the key features of digital technology, e.g. various externalities, contribute to further developments that could lead to its more intensive use? Chapter 2 examines how the science system contributes to developing capabilities that can support the digital transition and how the former is impacted by changes in the possibilities and costs associated with digital economic activity (Goldfarb and Tucker, 2017). In science, as in several other fields, the greater information availability brought about by the digital revolution does not necessarily result in greater information quality. Not surprisingly, then, considerable effort in science and innovation aims to deploy digital technologies to help make information useful for meaningful and reliable quality assurance, classification, and prediction. As a result, this chapter also dedicates space to discussing trends and features of research activity related to automating human-like cognitive functions through artificial intelligence (AI). AI is both a general-purpose technology – i.e., it has a wide domain of applications – as well as a new method of research and invention (Agrawal, Gans, and Goldfarb, 2018; Cockburn, Henderson, and Stern, 2018; Klinger, Mateo's-Garcia and Stathoulopoulos, 2018). Other developments, such as those related to developing computer-enabled tamper-proof mechanisms for trust and assurance, are not covered here for reasons of space and limited statistical evidence but can be just as important.

5. The Impact of Technology on the Environment:

The industrial revolution has brought about new technologies with immense power. This was the transition to new manufacturing processes in Europe and the United States, in the period from about 1760 to 1840. This has been succeeded by continued industrialization and further technological advancements in developed countries around the world, and the impact of this technology on the environment has included the misuse and damage of our natural earth. These technologies have damaged our world in two main ways: pollution and the depletion of natural resources.

1. Air and water pollution

Air pollution occurs when harmful or excessive quantities of gases such as carbon dioxide, carbon monoxide, sulfur dioxide, nitric oxide, and methane are introduced into the earth's atmosphere. The main sources all relate to technologies that emerged following the industrial revolution such as the burning of fossil fuels, factories, power stations, mass agriculture, and vehicles. The consequences of air pollution include negative health impacts for humans and animals and global warming, whereby the increased amount of greenhouse gases in the air traps thermal energy in the Earth's atmosphere and cause the global temperature to rise. Water pollution on the other hand is the contamination of water bodies such as lakes, rivers, oceans, and groundwater, usually due to human activities. Some of the most common water pollutants are domestic waste, industrial effluents and insecticides, and pesticides. A specific example is the release of inadequately treated wastewater into natural water bodies, which can lead to the degradation of aquatic ecosystems. Other detrimental effects include diseases such as typhoid and cholera, eutrophication, and the destruction of ecosystems which negatively affects the food chain.

FIG 8

2. Depletion of natural resources

Resource depletion is another negative impact of technology on the environment. It refers to the consumption of a resource faster than it can be replenished. Natural resources consist of those that are in existence without humans having created them and they can be either renewable or nonrenewable. There are several types of resource depletion, with the most severe being aquifer depletion, deforestation, mining for fossil fuels and minerals, contamination of resources, soil erosion, and overconsumption of resources. These mainly occur as a result of agriculture, mining, water usage, and consumption of fossil fuels, all of which have been enabled by advancements in technology. Due to the increasing global population, levels of natural resource degradation are also increasing. This has resulted in the estimation of the world's eco-footprint to be one and a half times the ability of the earth to sustainably provide everyone with enough resources that meet their consumption levels. Since the industrial revolution, large-scale mineral and oil exploration has been increasing, causing more and more natural oil and mineral depletion. Combined with advancements in technology, development and research, the exploitation of minerals has become easier, and humans are therefore digging deeper to access more which has led to many resources entering a production decline. Moreover, the consequence of deforestation has never been more severe, with the World Bank reporting that the net loss of global forest between 1990 and 2015 was 1.3 million km2. This is primarily for agricultural reasons but also logging for fuel and making space for residential areas, encouraged by increasing population pressure. Not only does this result in a loss of trees which are important as they remove carbon dioxide from the atmosphere, but thousands of plants and animals lose their natural habitats and have become extinct.


FIG 9

6. Reduce and adapt to the effect of climate change

You maybe aware of the weather. Weather refers to the daily variations in what we see and experience outside. One day it may rain, while the next it may be bright. It gets cold sometimes. It can get quite warm. The weather varies by location as well. In one location, people may be playing outside in shorts. People may be shoveling snow from afar at the same time.

FIG10

3The term "climate change" refers to a shift in a location's typical weather patterns. This could be due to a shift in the amount of rain that a location receives on an annual basis. It could also be a month or season-long shift in a location's normal temperature. A change in the Earth's climate is also known as climate change. This may be due to a shift in the Earth's normal temperature. It could also represent a shift in the normal distribution of rain and snow on the planet. In just a few hours, the weather can completely shift. Climate change can take hundreds of years or perhaps millions. A place's climate refers to its typical weather. Seasonal climates vary. In the summer, a location could be predominantly hot and dry. In the winter, the same location may be cold and damp. Climates differ depending on where you go. Climate change can be brought on by a variety of factors. The distance between the Earth and the sun varies. Energy can be emitted by the sun. Oceans have the potential to shift. A volcano's eruption has the potential to alter our climate. Humans, according to most scientists, can also alter the climate. Cars are used by people. Households are heated and cooled. Food is prepared. It takes a lot of energy to do all those things. Coal, oil, and gas are examples of energy sources. Gasses are released into the air when these items are burned. The gasses heat the air. This has the potential to alter a location's climate. It can alter the Earth's climate as well. Scientists believe that the Earth's temperature will continue to rise over the next 100 years. More snow and ice would melt as a result. Oceans would rise even more. Some areas would become hotter. Winters in other parts of the country may be colder and snowier. Some areas may see more rain than others. There may be less rain in other regions. Hurricanes could be stronger in some areas.

Problem to be solved:

Definition:

Egypt has been focused on industrial specialization for the past seven years, with the sectors involved including textiles, pharmaceuticals, and furniture. Specialized units and industrial zones targeting the development of small and medium-sized enterprises (SMEs) have been established in many governorates, with each finding the best industrial match for its resources. There are now 17 industrial complexes across 15 governorates, with these generating 84,000 direct job opportunities at a total cost of LE10 million. The complexes have been established using the highest technological standards to provide the correct environment for industrial investment, said the Ministry of Trade and Industry. Licensed factories can be rented, making things easier for young entrepreneurs who may not have the capital to buy their facilities. Government bodies have contributed to providing services to these factories by establishing specialized centers for knowledge transfer, training, and technical support. These facilities are one of how local components can be deepened in the country's industries, avoiding imports wherever local alternatives are available.

FIG 11

Causes:

the manufacturing sector share has remained relatively low, not exceeding 30%. Indeed, this sector has faced several problems that affected its competitiveness (especially institutional barriers as it is shown in Figure 2). Indeed, Figure 2 shows that Egypt (compared to other comparable economies, such as Tunisia, Morocco, Jordan, Lebanon, Brazil, Poland, and Turkey) is suffering from a lack of rule of law, low protection of property rights, a lack of market competition and the relative absence of anti-monopoly practices and laws. Moreover, the innovative capacity in Egypt is relatively low, which in turn affects its competitiveness and increases its specialization in traditional exports. Indeed, shows that Egypt has a low share of medium- and high-tech activities in its industrial sector. The currency crisis delayed important letters of credit for the imports of raw materials required for the industry. This led to a shortage of raw materials and an increase in prices. Further, loans became more difficult as banks lent industrial companies with an investment rate of up to 14% and 15%, imposing extra costs on local producers, and making it hard for them to purchase imported materials for production. There is also another cause of the problem there is a deterioration in the land, sea, and air trade transportation lines between Egypt and world countries, which has led to the delayed exportation of Egyptian gods and caused damage to some, particularly food products and this led to the difficulty and increased cost of the materials needed for the industry. Since late 2014, Egypt has been witnessing a crisis in terms of the availability of natural gas and fuel, upon which most of the factories rely. This shortage has obstructed production. Raw materials consist of only 8% of Egypt's exports. The fuel crisis of 2014-15 has hindered factories' activities, which produce a large part of Egyptian exports. Using nonrenewable energy is another problem in the industrial sector in Egypt, this problem is caused by many factors such as the high cost of the installation of the solar cells.

Consequences:

Positive effects of the industrial sector:

Egypt has received high marks from the International Monetary Fund (IMF) for carrying out a series of difficult economic reforms and for its success as an emerging market. However, such positive trends mask a deeply troubling domestic scene that includes rising poverty, a squeezed middle class, high food prices, persistently rising youth unemployment, and increasing political repression. Moreover, although the government often repeats a pledge to stamp out terrorism, violence by extremist groups in the northern Sinai as well as the Cairo region continues. Despite sharp criticism from international human rights organizations and liberal activists, the government of President Abdel-Fattah el-Sisi has been buoyed by the support of key global leaders, namely Russia and some Arab Gulf states—particularly Saudi Arabia and the United Arab Emirates—and US President Donald Trump. This international support and the stifling of dissent at home have enabled the Sisi government to maintain tight control over the Egyptian polity, but it is an approach that is not sustainable over the long term. With the country's burgeoning population of over 100 million and high debt payments that leave little room to improve social services, the government needs to change its military-based approach. Opening up the political and economic systems would allow for sustained private sector growth and a free flow of ideas—and criticism—that would keep the public sector accountable. On paper, Egypt's economy is doing well. It is nearing the completion of a three-year economic reform program that included $12 billion in loans from the IMF in return for the devaluation of the Egyptian pound, the introduction of a value-added tax, and the cutting of subsidies on energy products and some food items like cooking oil. Such policies have helped the government reduce its large budget deficit which, in the fiscal year 2018-2019, is estimated to be about half of what it was in 2017-2018. Moreover, the IMF predicts a GDP growth rate of 5.3 percent in 2019. Some of the success stories include tourism, which generated $11.4 billion in 2018 compared with $7.6

billion in 2017, and the large Zohr gas field located in Egypt's portion of the Mediterranean Sea, which holds great potential. For many of these reasons, *The Economist* has referred to Egypt as "the world's hottest emerging market."

Negative effects on the industrial sector:

1. **Horrible Living Conditions for Workers**
   As cities grew during the Industrial Revolution, there wasn't enough housing for all the new inhabitants, who were jammed into squalid inner-city neighborhoods as more affluent residents fled to the suburbs The lack of clean water and gutters overflowing with sewage from basement cesspits made workers and their families vulnerable to infectious diseases such as cholera.
2. **Poor Nutrition**
   In his 1832 study entitled "Moral and Physical Condition of the Working Classes Employed in the Cotton Manufacture in Manchester," physician and social reformer James Phillips Kay described the meager diet of the British industrial city's lowly-paid laborers, who subsisted on a breakfast of tea or coffee with a little bread, and a midday meal that typically consisted of boiled potatoes, melted lard and butter, sometimes with a few pieces of fried fatty bacon mixed in. After finishing work, laborers might have some more tea, "often mingled with spirits" and a little bread, or else oatmeal and potatoes again. As a result of malnutrition, Kay wrote, workers frequently suffered from problems with their stomachs and bowels, lost weight, and had skin that was "pale, leaden-colored, or of the yellow hue."

3. **A Stressful, Unsatisfying Lifestyle**

Workers who came from the countryside to the cities had to adjust to a very different rhythm of existence, with little personal autonomy. They had to arrive when the factory whistle blew, or else face being locked out and losing their pay, and even being forced to pay fines. Once on the job, they couldn't freely move around or catch a breather if they needed one since

FIG 12

that might necessitate shutting down a machine. Unlike craftsmen in rural towns, their days often consisted of having to perform repetitive tasks, and continual pressure to keep up— "faster pace, more supervision, less pride," as Peter N. Stearns, a historian at George Mason University, explains. As Stearns describes in his 2013 book The Industrial Revolution in World History, when the workday finally was done, they didn't have much time or energy left for any sort of recreation.

4. **Dangerous Workplaces**

Without much in the way of safety regulation, factories of the Industrial Revolution could be horrifyingly hazardous. As Peter Capuano details in his 2015 book Changing Hands: Industry, Evolution and the Reconfiguration of the Victorian Body, workers faced the constant risk of losing a hand in the machinery. A contemporary newspaper account described the grisly injuries suffered

FIG 13

in 1830 by millworker Daniel Buckley, whose left hand was "caught and lacerated, and his fingers crushed" before his coworkers could stop the equipment. He eventually died because of the trauma. Mines of the era, which supplied the coal needed to keep steam-powered machines running, had terrible accidents as well.

5. **Child Labor**

While children worked before the Industrial Revolution, the rapid growth of factors created such a demand that poor youth and orphans were plucked from London's poorhouses and housed in mill dormitories, while they worked long hours and were deprived of education. Compelled to do dangerous adult jobs, children often suffered horrifying fates. John Brown's expose A Memoir of Robert Blincoe, an Orphan Boy, published in 1832, describes a 10-year-old girl named Mary Richards whose apron became caught in the machinery in a textile mill.

FIG 14

6. **Discrimination Against Women**

The Industrial Revolution helped establish patterns of gender inequality in the workplace that lasted in the eras that followed. Laura L. Frader, a retired professor of history at Northeastern University and author of The Industrial Revolution: A History in Documents, notes that factory owners often paid women only half of what men got for the same work, based on the false assumption that women didn't need to support families, and we're only working for "pin money" that a husband might give them to pay for non-essential personal items.

FIG 15

Discrimination against and stereotyping of women workers continued into the Second Industrial Revolution.

7. **Environmental Harm**

Pollution from copper factories in Cornwall, England, as depicted in an engraving from History of England by Rollins, 1887. Pollution from copper factories in Cornwall, England, as depicted in an 1887 engraving. The Industrial Revolution was powered by burning coal, and big industrial cities began pumping vast quantities of pollution into the atmosphere. London's concentration of suspended particulate matter rose dramatically between 1760 and 1830, as this chart from Our World In Data illustrates. Pollution in Manchester was so awful that writer Hugh Miller noted "the lurid gloom of the atmosphere that overhangs it," and described "the innumerable chimneys [that] come in view, tall and dim in the dun haze, each bearing atop its pennon of darkness." Air pollution continued to rise in the 1800s, causing respiratory illness and higher death rates in areas that burned more coal. Worse yet, the burning of fossil fuels pumped carbon into the atmosphere. A study published in 2016 in Nature suggests that climate change driven by human activity began as early as the 1830s. Despite all these ills, the Industrial Revolution had positive effects, such as creating economic growth and making goods more available. It also helped lead to the rise of a prosperous middle class that grabbed some of the economic power once held by aristocrats and led to the rise of specialized jobs in the industry.

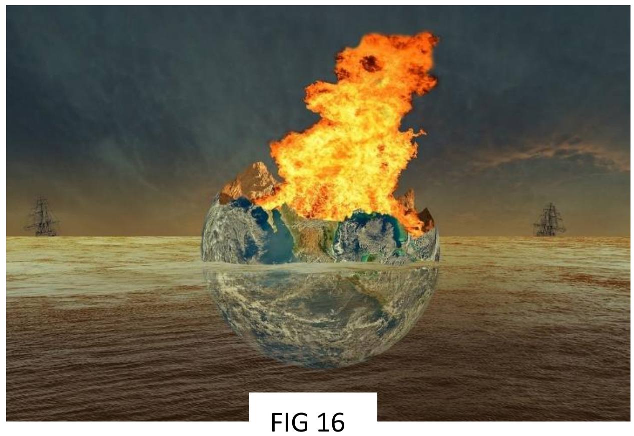


FIG 16

Research

Recycling: Recycling is the process of converting waste materials into new materials and objects. The recovery of energy from waste materials is often included in this concept. The recyclability of a material depends on its ability to reacquire the properties it had in its original state.

industry: In macroeconomics, an industry is a branch of an economy that produces a closely-related set of raw materials, goods, or services. For example, one might refer to the wood industry or the insurance industry.

pollution: Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of any substance or energy. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

Technology and environment: Technology has profoundly shaped society, the economy, and the environment. Technology has caused many environmental and social problems, but it is also key to addressing environmental degradation, climate change, food scarcity, waste management, and other pressing global challenges.

Climate change: Climate change has contributed to the expansion of drier climate zones, such as the expansion of deserts in the subtropics. The size and speed of global warming are making abrupt changes in ecosystems more likely. Overall, it is expected that climate change will result in the extinction of many species.

Green energy: Renewable energy is energy that is collected from renewable resources that are naturally replenished on a human timescale. It includes sources such as sunlight, wind, rain, tides, waves, and geothermal heat. Although most renewable energy sources are sustainable, some are not.

wasted material: any materials unused and rejected as worthless or unwanted. synonyms: waste, waste matter, a waste product.

feedback system: A feedback system compares its output to the desired input and takes corrective action to force the output to follow the input.

depletion of natural resources: It refers to the consumption of a resource faster than it can be replenished.

economic system: An economic system, or economic order, is a system of production, resource allocation, and distribution of goods and services within a society or a given geographic area.

Prior solutions:

1. concrete:

To sustain the environment, it is crucial to find solutions to deal with waste, pollution, depletion, and degradation of resources. In construction, large amounts of concrete from buildings demolitions made up 30-40 % of total waste. Expensive dumping costs, landfill taxes, and limited disposal sites give chance to develop recycled concrete. Recycled aggregates were used for reconstructing damaged infrastructures and roads after World War II. However, recycled concrete consists of fly ash, slag, and recycled aggregate and is not widely used because of its poor quality compared with ordinary concrete. many researchers investigate the possibility of using recycled concrete in construction applications as normal concrete. Methods include a varying proportion of replacing natural aggregate with recycled aggregate and the substitute of cement by associated slag

from 0 % to 20% on the strength criteria of M_{30} Concrete.

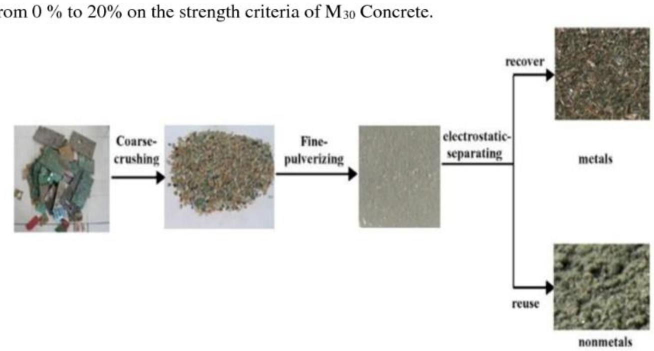


FIG 17 Whole process of integrated recycling for waste PCBs

cement with fly ash. The study reveals that slag and fly ash are effective supplementary elements in improving the properties of the concrete with cement. But, without cement, these two elements do not play an important role in improving the properties. Also, slag is more useful than fly ash if its amount does not go higher than 50%. Moreover, recycled aggregate contributes positively to the concrete mixture, in terms of compression strength. Finally, concrete strength increases when the amount of the RA augments is related to either the high quality of RA or the method of mixing or both.

Pros:

- eco-friendly
- low cost
- exploit wasted concrete

Cons:

- poor quality compared to an ordinary one.

2. Alcohol:

During 1941 and 1942 it became evident that the productive capacity of the alcohol industry was considerably short of the greatly increased demand incurred chiefly by the pyramiding of wartime needs upon a peace time structure. This situation brought about far-reaching changes in the usual methods of production and distribution of ethyl alcohol. Under normal conditions, 'Customs and Excise duties and tariffs prohibit the crossing of alcohol into the United States unless such alcohol is to be utilized in the manufacture or blending of beverages where the selling price is sufficiently

FIG 18

high to absorb such charges. An agreement was reached by which industrial alcohol could be imported free of any charge into the United States for use in essential war materials, such as synthetic rubber and explosives, etc. However, even after the expansion of productive capacity in Canadian and American distilleries and the availability of Canadian alcohol in the United States, the demand for alcohol far exceeded the supply. To assist in satisfying this demand, The Ontario Paper Company, Limited, at the request of the Canadian Department of Munitions and Supply, and its own expense, commenced the construction of an alcohol plant to manufacture alcohol from waste sulfite liquor. Of great value in carrying out this project to a successful conclusion was the fact that the services of Dr. M. M.Rosten, a consulting chemical engineer, were available. Dr. Rosten, before the war, owned and operated the Kutno Chemical Works in Poland which produced absolute alcohol and its derivatives. The Kutno plant began production of power alcohol in 1927 and was the first of its kind in Eastern Europe. Dr. Rosten contributed largely to the design, installation, and initial operation of the plant at Thorold. A little over eight months elapsed from the time that construction was commenced until the first carload of alcohol was shipped. During this period there was a continuous struggle with priority difficulties and shortage of appropriate materials.

Pros:

- have multi-uses
- low cost

Cons:

- shortage of appropriate material

3. Recycled Paper Processing Mills:

Recycled paper processing mills use paper as their feedstock. The recovered paper is combined with water in a large vessel called a pulper that acts like a blender to separate fibers in the paper sheets from each other. The resultant slurry then passes through screens and other separation processes to remove contaminants such as ink, clays, dirt, plastic, and metals. The number of contaminants that are acceptable in the pulp depends upon the type of paper being produced. Mechanical separation equipment includes coarse and fine screens, centrifugal cleaners, and dispersion or kneading units that break apart ink particles. Deinking processes use special systems aided by soaps or surfactants to wash or float ink and other particles away from the fiber. Recovered fiber can be used to produce new paper products made entirely of recovered fiber (i.e. 100 percent recycled content) or from a blend of recovered and virgin fiber. Fiber cannot, however, be recycled endlessly. It is generally accepted that a fiber can be used five to seven times before it becomes too short (as a result of repulping and another handling) to be useable in new paper products. Recovered paper with long cellulose fibers (such as office paper) has the greatest flexibility for recycling as it can be used to produce new paper products that use either long or short fibers. Recovered paper with short cellulose fibers (such as newspaper) can only be recycled into other products that use short cellulose fibers. For this reason, recovered paper with long fibers is generally of higher value than recovered paper with short fibers.

FIG 19

Pros:

- produce many products
- easy to implement
- low cost

Cons:

- requires a large amount of manpower.

4.producing soap from cooking oil:

FIG 20

Reducing the number of different types of municipal waste. •Recycling waste to obtain a useful green soap, which is good quality and cheap. • Inspiring community projects meant to convey recycling and ecological approach. • Contributing to families' economy and stimulating the use of healthier products. – Abstract: A green perspective based on the reuse of waste materials such as almond shells, orange peel, and used cooking oil to manufacture soap is presented. In Portugal, thousands of tons of waste are generated from used cooking oil, and the production of nut shells' residues is growing every year. In addition, the high consumption of citrus fruits, and oranges generates large amounts of citrus peel. Therefore, it is necessary to diversify the reuse mechanisms of these wastes, to make them back into raw materials.

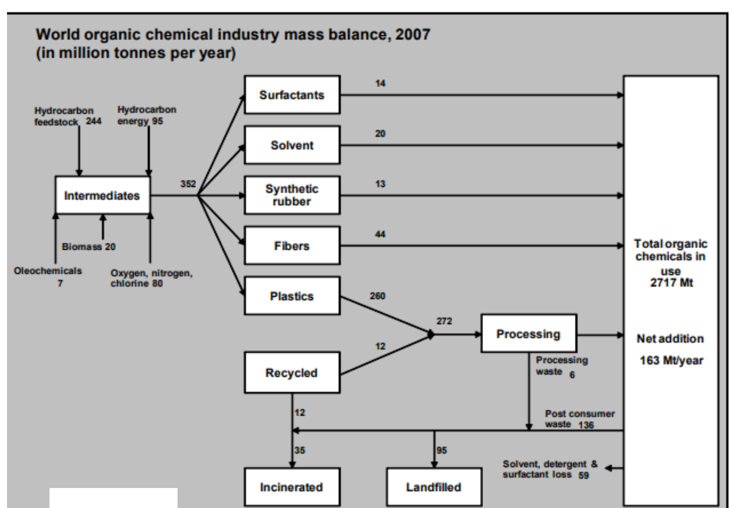


FIG 21

Complying with this trend, this work was carried out by processing and grinding almond shells, treating used oil, processing orange peels and extracting limonene, formulating and producing soap, and performing an acceptance study of the final product. Results validated the high potential of the idea in the field of environmental education, so it can be replicated in practical classes. It can also be useful for waste management, and it can support the development of community projects on an ecological approach.

Pros:

- simple to implement
- reduce the number of unemployed.

Cons:

- Already developed before and simple manufacture.

5. Fuel for process

heat Steam is typically generated by fossil fuels in steam boilers at high conversion efficiencies of about 90%. However, biomass can also be used to generate steam. Today typical sources are wood waste (e.g., bark, black liquor) used in the pulp and paper sector and charcoal used in small-scale blast furnaces (Taibi, Gielen, and Bazilian, 2012). Although biomass combustion for steam production is currently limited, there are 0 10 20 30 40 50 60 70 80 OECD Countries non-OECD Countries Low temp heat Medium temp heat High temp heat Total final energy use (EJ/yr) Chemical and petrochemical Iron and steel Non-

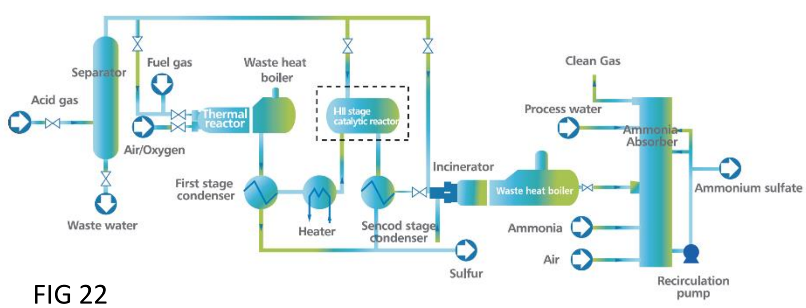


FIG 22

metallic mineral Paper, Pulp and Printing Non-ferrous metals Food, Beverage and Tobacco Machinery Textile and leather Transport equipment Mining and quarrying Wood and wood products Construction Non-specific Total industry world-wide (only fuels heat, excl. electricity feedstocks) 9 large potential to provide low and medium temperature steam.

Pros:

- Eco-friendly
- exploit green energy

Cons:

- not applicable in all places.

6.Feedstock for chemicals and polymers

Feedstock energy refers to the use of fuels as raw material in the production of organic chemicals and polymers (i.e., materials). Five feedstock-consuming processes in the chemical and petrochemical sector convert fossil fuels into basic chemicals. These are the steam cracking process (for ethylene, propylene, butadiene, and aromatics production) and ammonia, methanol, carbon black, and carbides production processes. The steam cracking process uses large amounts of naphtha (in Europe, Japan, Latin America, and non-OECD Asian countries) and ethane/propane (in the US, the Middle East, and North Africa). In comparison, methanol and ammonia production processes use mainly natural gas worldwide, except in India and China, which use large quantities of petroleum products and coal, respectively. The main feedstock for carbon black and carbides

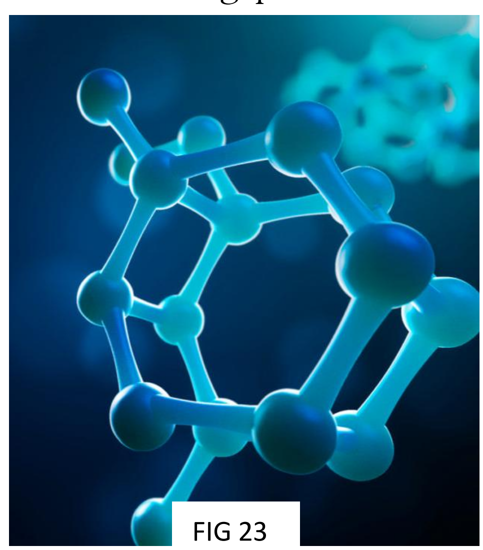


FIG 23

productions are oil and petroleum coke, respectively. About 60% of the total feedstock used in the chemical and petrochemical sector is for the steam cracking process and the remainder 40% is shared between ammonia production (32%) and other processes (8%) (Daioglou et al., 2014). Total fossil fuel-based feedstock use reached 21 EJ in 2009 (IEA, 2012b). Today only a small share of the total feedstock demand originates from biomass (0.6 EJ) (Sagging et al., 2014). The basic chemicals are converted into plastics and fibers which account for about ~85% of the total synthetic organic materials production (~290 megatonnes (Mt) per year) and their production is expected to 10 continue growing (IEA, 2009) Technically, 90% of all polymers and fibers can be produced from bio-based feedstocks (Shen, Worrell and Patel, 2010).

Pros:

- convert exhausted materials into living ones
- have multi-benefits

Cons:

- sophisticated to implement.

7.Glass production transition to renewable fuels

Carbon dioxide emissions are one of the pressing issues for energy-intensive industries. Although hydrogen energy processes are comparatively more expensive at the moment, a gradual improvement in benefits can be expected within 5-7 years and, consequently, increased interest in such solutions in energy-intensive industries. In 2017 Steklarna

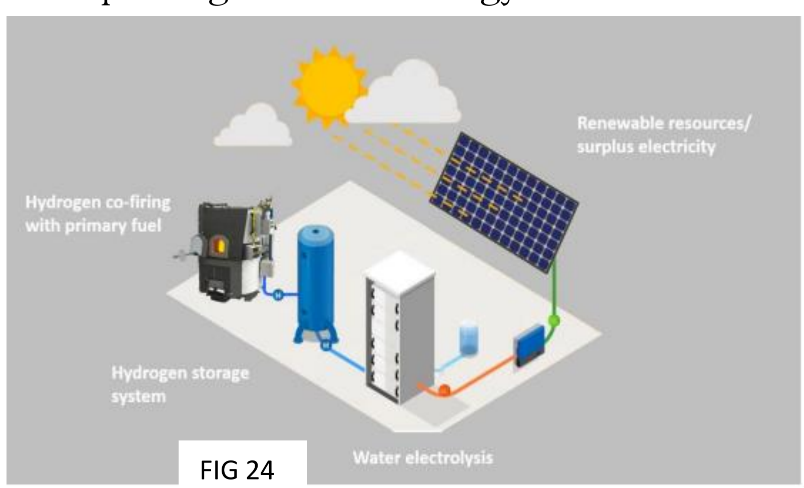


FIG 24

Hrastnik, a glass manufacturer from Slovenia started a project for optimization of energy conversion to replace the share of fossil fuels used for industrial glass melting with hydrogen (OPERH2). The project introduced renewable energy sources (use of solar cells), the production and storage of green hydrogen gas, and the partial addition of the latter to the natural gas feed to make a further first step towards renewability. The system was successfully commissioned in 2020, and experimental results showed a remarkable potential for energy flexibility of melting glass with hydrogen-natural gas fuel mixtures. Demonstration envisaging the full fuel ramping from the non-renewable natural gas to hydrogen, simultaneously considering the flexibility of operation, the quality of product, and the profitability of manufacturing. The system components were checked at a small-scale industrial demonstration of 200 kg /day capacity (TRL 7). After testing the technology at the pilot scale Steklarna Hrastnik aims to qualify and implement hydrogen melting at an industrial scale (TRL 9) shortly. The technology will be implemented in the existing oxyfuel furnace built in 2020 at Steklarna Hrastnik's site in Hrastnik (Slovenia) with a nameplate capacity of 120 tons per day, where hydrogen fuel will on average replace 50 vol% of primary fuel, resulting in approx. 20% lower GHG emission from the fuel.

Pros:

- produce green energy
- use replace unclean energy with a clean one.

Cons:

- hydrogen processes are expensive right now

Design requirement:

whenever we start any capstone journey, we seek to solve a specific problem with the solution that we should present through our prototype. This semester we should solve the issue of the industrial sector in Egypt; if we could solve this problem, our country can rely on the industry only as of the main income as many developed countries do. Hence, we must carefully provide a solution by converting traditional industry using green energy or wasted material as an input for our industry. then, implementing a feedback system that can detect the characteristics of the product and if it contains the required or not. when we measure the success of any project we must compare our results with specific standards, those standards are the design requirements. During our journey of implementing our prototype, we seek to let our project meet the design requirements. Currently, we choose to modify in an industry that lately no one can dispatch. The manufacturing of copper sheets is multi-used; are used in electronic boards, touch screens, smart hand-bands, etc. we choose those below design requirements to concern them during the implementation of our prototype.

First: dimensions

The dimensions of anything are very necessary to be accurate, especially if they are in something like our industry. Those limited spaces for the electronic boards in laptops, computers, screens, etc; make the use very careful from this side. Hence, in our feedback system, we put ultrasonic sensors which are ordered with specific dimensions; they can be changed according to the required product to check its availability. In our test plan, we selected a specific template to reshape the copper sheet with a length= of 5 cm and a width = of 3 cm.

Second: weight:

Those sensitive and small parts in electronics or modern tools must be limited with a specific weight that can't be skipped. As I mentioned before, those copper sheets may use in large touch screens ad the same as smart hand-band. For that, it is not the same weight as all products but whatever this product is, it mustn't reach more than 25 grams.

Third: high handling

The stripboard sometimes has high-handling components connected to it. These components need special characteristics of their stripboard to be able to handle the high pressure on it. These characteristics are summarized in the high thickness; it must have the ability to handle more connections. the normal thickness of the breadboard is approximately 1.2, this value should be raised to 1.6 to be used in the high-handling. the efficiency of our copper sheet must be higher than the real one.

Fourth: heat proof

Some machines use types of boards that can withstand heat as these machines release large amounts of heat which can damage the board. The stripboard can be developed to be qualified to use in these machines. We can test the ability of this stripboard to withstand the heat using the TPM sensors which will be connected to the Arduino in the feedback system. Also, the purity of copper sheets demonstrates that it doesn't contain any other element to reduce their conductivity or reduce their melting point. As copper needs a very high temperature to even start to melt.

Generating and Defending a Solution

Selection of solution:

Recycling achieves the objective of keeping materials out of the landfill by turning them back into raw materials that will be used again to manufacture new products or items. Recycling is well-known for its environmental benefits, In Egypt, solid waste is currently disposed of in dump sites and has an indispensable potential for recycling, processing, or reuse. Municipal waste flow differentiates between urban and rural areas, and approximations have been derived from per capita Municipal Solid Waste generation rates by Governorate. In virtue of, this serious problem effect Egypt negatively and have many bad consequences that act as an of the major obstacles that face Egypt especially and the world generally. Hence, we asked to solve the challenge of recycling and sectors of agriculture and industry for the sake of raising the income of our country and making a peak in the Egyptian economy. As we have been asked to develop a traditional industry and re-create its manufacturing process with the development of its efficiency for the sake of providing the product by changing the insertable material to green energy that can be exploited as it is a renewable energy resource and ecofriendly; Also, we can substitute the insertable material with waste material which is wasted during any process of another manufacturing process by recycling it to be valid to get into another process. After that, we must contrast a feedback system which is responsible for checking the quality of the final product that had been given orders which are the design requirements that we put to measure the success of our prototype. Firstly, we deeply search into the most usable products for the new generations as same as the old ones.

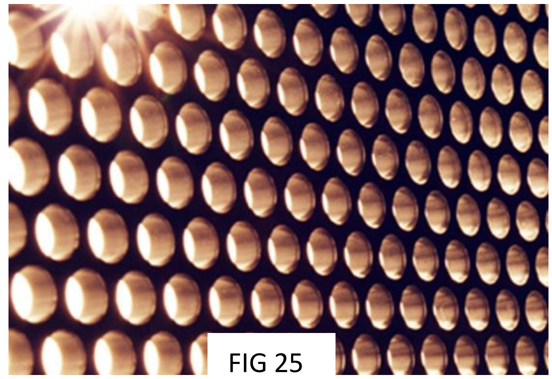


FIG 25

FIG 26

We found many industries that we could work on for their improvement. We found many examples like recycling the wastes of PCBs for the sake of manufacturing concrete; Although the development of this process can lead to a decrease in the cost and make it eco-friendly, any change in this industry is a major risk for the product's quality as any substitutions in the industry make the new product poor quality compared to the old one. Also, there is the industry that revolves around the production of glass

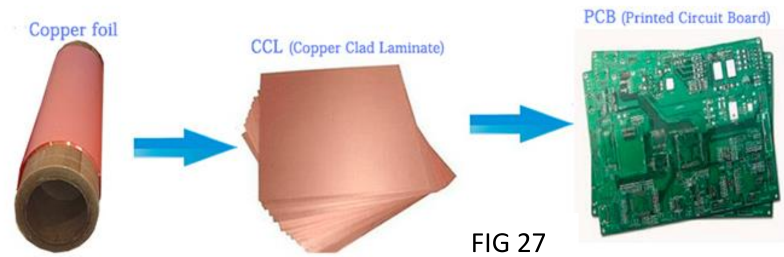


FIG 27

transition to renewable fuels, moreover, of being sophisticated to implement as a prototype, the hydrogen gas nowadays is so expensive to use, thus there will not be a balance between the total cost and the efficiency. All those prior solutions have pros and cons in addition to having a critical role in the development of many industries, but after much searching, we found that the most common products nowadays are electronics, we started to search more about electronic parts that could be developed; we decided to work on the electronic boards as they are almost the most common parts in many technological tools. We searched about the kinds of electronic boards; unfortunately, we found that kinds of boards as PCB boards need to make a manual manufacturing process and that what we didn't need as the automatic one is applicable in the real life. According to the expenses of metals including copper; we must prevent the wasting of copper in many industries such as the wine industry. subsequently, we decided to work on the manufacturing of copper sheets that have multi-uses that couldn't be dispatched; it can be used as the main base of any electronic board in addition to its use in touch screens and smart-band bracelets. You'll often find the fingertips of conductive "touchscreen gloves" embedded and lined with copper. Specifically, copper yarn is used in touchscreen gloves. The copper yarn allows the gloves to absorb some of the electrical current produced by capacitive touchscreens. Therefore, you can operate a capacitive touchscreen while wearing touchscreen gloves made of the copper yard. We used the mechanism of rolling as the first stage of the manufacturing


FIG 28

process, the forces on the grinding rollers and the stress on the rolling compac tion zone are the foundation for studying the vibration mechanism of the non-steady state of the vertical roller mill. The working principle of the High-pressure Roller Mill is two rolls, which are counter-rotating at the same circumferential speed. One roll is connected to bearings which create a radial force. The feed to the rolls creates a so-called "bed" of material in the roll gap.

Selection of prototype

To address Egypt's manufacturing issues, we selected to enhance the copper sheet industry, which is utilized in many electronic devices. To lower the cost of the process and to exploit wasted resources, the copper sheet would be manufactured using waste copper from used wires. Following the solution selection, we moved on to the prototype design. The prototype design is a critical component in meeting our product's design requirements. the selected design had two parts: the manufacturing process and the feedback system.

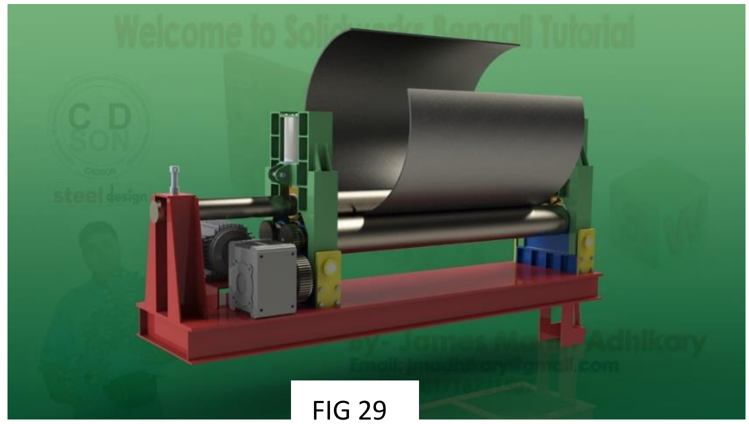


FIG 29

Manufacturing process:

The manufacturing part of the prototype was designed to manufacture the copper sheet from the wasted wire. It is consisting of two axes held by two gears. The two axes would be powered in reverse directions by a motor attached to them. A heater will be placed on each of the two axes to soften the copper for simple shaping, but there will be enough room between the ax and the heater for it to move. A templet would be designed with a length of 5 cm and width of 3 cm To shape the copper heated. Feedback system:

The feedback system consists of many sensors which predict any error in the manufactured copper sheet. The first sensor is the heat sensor which will measure the ability of the copper

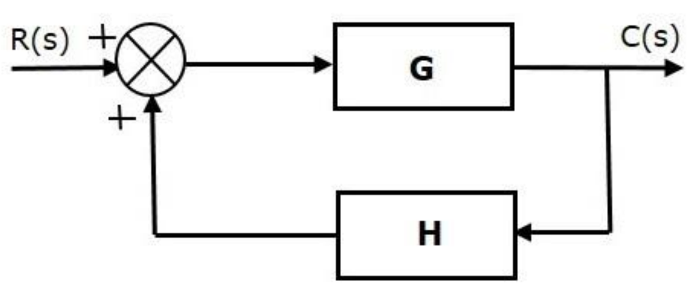


FIG 30

sheet to heat proofing. The next one is the ultrasonic sensor which measures the dimensions of the copper sheet and the loud cell (weight sensor) measures its weight. the Arduino nano would be used for giving the orders for different sensors, motors, and the heater. All components would be connected to the breadboard and held on a conveyer belt which will receive the copper sheet from the manufacturing process.

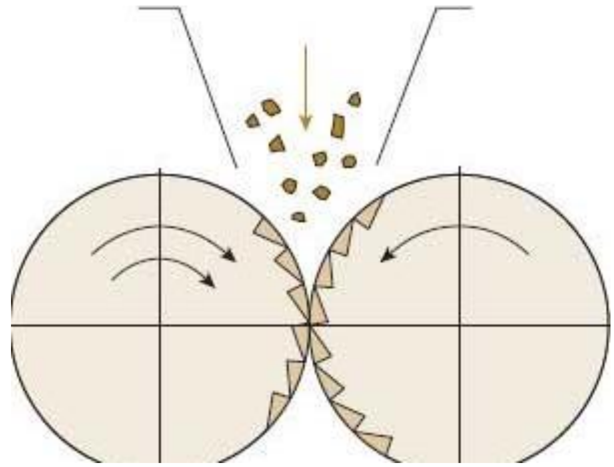
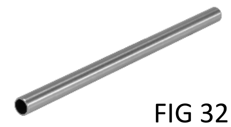
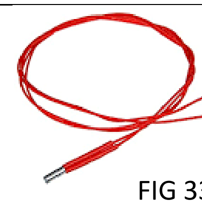
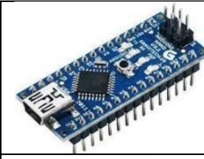
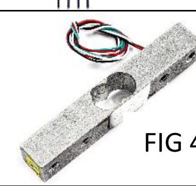
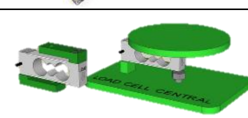


FIG 31

Constructi ng and Testing a Prototype

Materials:

Name	Description	Place	Quantity	Price	Photo
Axis	Enables materials to be rolled around it.	Elramlly	2	20 L.E	 FIG 32
Heater	devices used for adding thermal energy to or raising the temperature	Amazon	1	36 L.E	 FIG 33
Metal gears	It is a rotating circular machine part having cut teeth or, in the case of a cogwheel or gearwheel,	Elramlly	2	10 L.E	 FIG 34
Wood	Wood is a porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. It is an organic material	Carpenter	30*30 cm	10 L.E	 FIG 35
Wood fiber	Wood fibers are usually cellulosic elements that are extracted from trees and used to make materials including paper	Carpenter	20*10 cm	50 L.E	 FIG 36
DC Motor	A DC motor is an electrical machine that converts electrical energy into mechanical energy.	RAM	1	300 L.E	 FIG 37
TMP Sensor	A temperature sensor is a device used to measure temperature	RAM	1	10 L.E	 FIG 38
Relay Module	Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch.	Menof Magic	1	16 L.E	 FIG 39

Arduino Nano	Arduino Nano is a small, compatible open-source electronic development board based on an 8-bit AVR microcontroller.	RAM	1	95 L.E	 FIG 40
Battery 3.7 V	The 3.7v lithium battery is a lithium battery with a nominal voltage of 3.7v and a full-charge voltage of 4.2v	Circuits Electronics	3	75 L.E	 FIG 41
Battery holder	A battery holder is either a plastic case with the shape of the housing molded as a compartment or compartments that accept a battery or batteries	Circuits Electronics	1	6 L.E	 FIG 42
Battery 9 v	The 9V battery is an extremely common battery that was first used in transistor radios. It features a rectangular prism shape that utilizes a pair of snap connectors which are located at the top of the battery	RAM	1	15 L.E	 FIG 43
Motor	A motor converts electrical energy into mechanical energy.	RAM	2	40 L.E	 FIG 44
Ultrasonic Sensor	ultrasonic sensors measure distance by using ultrasonic waves.	RAM	2	90 L.E	 FIG 45
Load Cell	A load cell is a transducer that converts the mechanical force into readable electrical units	Circuits Electronics	1	86 L.E	 FIG 46
3D printed shape	Shape in 3 dimensions (x, y, z)	Machine in school	1	0 L.E	 FIG 47
				869 L.E	

Methods

In our capstone project, we seek to solve the problem of manufacturing in Egypt. we should solve the problem by using green energy or wasted materials to solve the problem. we identified the problem which was the improvement of manufacturing copper sheets.

FIG 48

We use the copper sheet in our daily life in smartphones and electronic materials. To achieve our design requirements we set our prototype design and then followed some specific steps to build it which are:

Manufacturing process:

- We get the two-axis and sand the two sides of each one to make them have a smaller radius. Decreasing the radius makes the two-axis able to be closer to each other as the copper sheet will pass from it.
- We get the two-metal gears and put them on each side of one of the two axes.
- The other axis was pierced from the middle on one side to put the motor which is held by a nail. By connecting the electricity the motor will power the two-axis to roll in reverse.
- We put the heater on an aluminum plate and connect it to a relay module to control the heat degree.
- The heater is connected to a battery.

- A heat sensor was put on the axis keeping a small space between them to capable the two-axis moving.
- A template was designed with specific dimensions and printed using a 3D printer to put the copper sheet into it manually to make it shape with the required dimensions.
- A mold was designed on the computer to put the two-axis and the whole manufacturing process on it to organize it.
- the fiber wood (heat proofing) had cut by laser cutter depending on the designed mold and the axis is installed on it.

Feedback system:

- A conveyer belt was built by using wood fixed on two rolls to transfer the product from the manufacturing process to the feedback system.
- The ultrasonic sensor was connected to the breadboard to detect the dimensions of the copper sheet.
- The load cell (weight sensor) was connected to the breadboard to measure the weight of the sheet copper.
- The Arduino Nano was connected to the breadboard. The ultrasonic sensor, the relay module, and the load cell were connected to the Arduino Nano using jumpers.
- The code of the Arduino was written to give orders to the sensors and the heater with specific values.

Test Plan

After we finish our project, we want to detect that it meets the design requirements. So, we will do some tests on our prototype that would detect that.

Efficiency test:

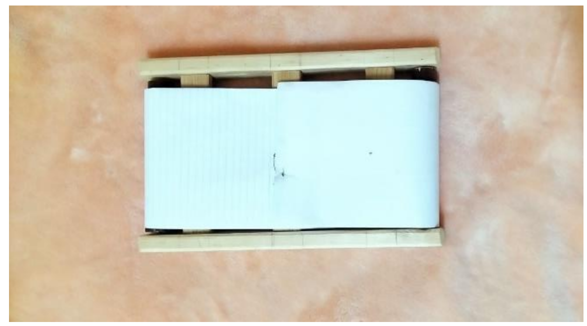


FIG 49

The stripboard sometimes has high-handling components connected to it. These components need special characteristics of their stripboard to be able to handle the high pressure on it. the normal thickness of the breadboard is approximately 1.2 cm, this value should be raised to 1.6 to be used in the high handling. 2 Ultrasonic sensors were put to measure the thickness from two sides.

Heat Proof Test:

The stripboard can be developed to be qualified to use in these machines. We can test the ability of this stripboard to withstand the heat using the TMP sensor which will be connected to the Arduino in the feedback system.

Dimensions test:

Hence, in our feedback system, we put ultrasonic sensors which are ordered with specific dimensions; they can be changed according to the required product to check its availability. In our test plan, we selected a specific template to reshape the copper sheet with a length= of 5 cm and a width = of 3 cm. 2 Ultrasonic Sensors were put on each side of the copper sheet to measure the width and length. Each one will measure the dimensions.

Weight test:

Copper sheets may use in large touch screens ad the same as smart hand-band. For that, it is not the same weight as all products but whatever this product is, it mustn't reach more than 25 grams. The load cell was put at the end of the feedback system to measure the wight and a 3D shape was printed to help the load cell to endure the weight and measure it.

Data Collection

When we started to test our prototype according to the plan that we set. Also, calculate the results and measures that are required to prove to design requirements to measure the success of the prototype in three different trials to check the precision and accuracy.

Dimensions:

According to the importance of the dimensions of the copper sheet, we tested its dimensions in three trials by repeating the process three times. We observed the diversity of the copper sheets' dimensions in every trial in addition to the ultrasonic sensors that detect the measures of copper sheets in every trial with a big difference. Subsequently, we add a manual step which is making templates with the required dimensions to press it on the copper sheet before reaching the

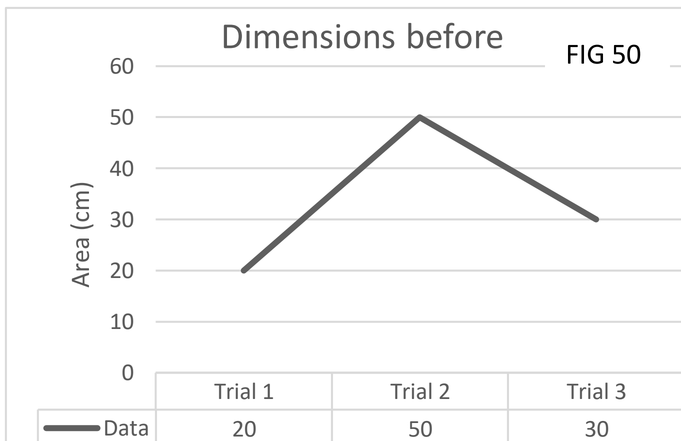


FIG 50

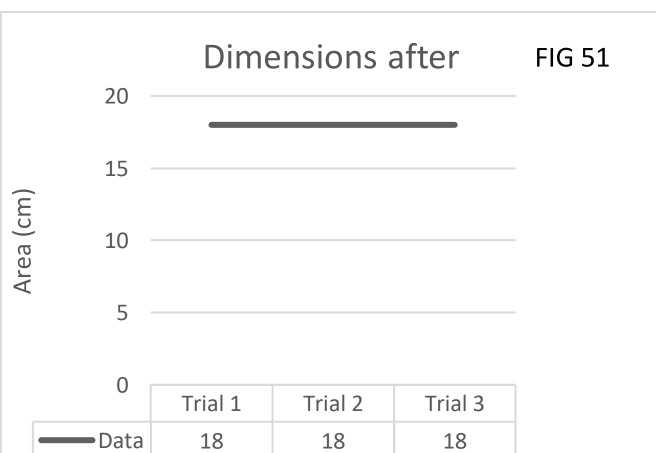


FIG 51

feedback system then, we compared the three trials before adding the dimensions template and after; the two following graphs are illustrating this.

Weight:

After modifying the manufacturing process with the metal template, we got the stability and balancing results in our measurements that have been observed and detected by the feedback system. We got precise results with the required weight with accuracy ± 0.02 gram.

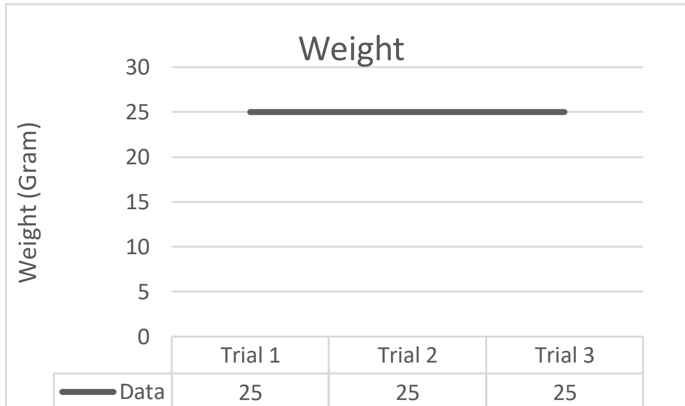


FIG 52

High handling:

According to depending on the material of the copper sheet. We tested high handling by checking the nature of inserted wasted material. We checked the conductivity of wasted material by measuring resistivity and we found it = 1.7 x 10^-8 ohm.

Heat proof:

we confirmed the heat proofing from previous checking the nature of copper and its conductivity. Also, when it passed through a heater of 350 Celsius.

Evaluation, Reflection, Recommendations

Dissection:

Recycling achieves the objective of keeping materials out of the landfill by turning them back into raw materials that will be used again to manufacture new products or items. In Egypt solid waste currently disposed of in dump sites has an indispensable potential for recycling, processing, or reuse. We have been asked to solve the challenge of recycling and sectors of agriculture and industry for the sake of raising the income of our country and making a peak in the Egyptian economy. We search for the most usable products for the new generations as same as the old ones. After that, we must contrast a feedback system which is responsible for checking the quality of the final product that had been given orders. We found many examples like recycling the wastes of PCBs for the sake of manufacturing concrete;

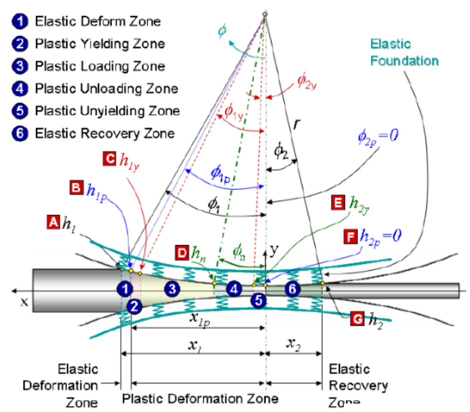


FIG 53

any change in this industry is a major risk for the product's quality. Also, there is the industry that revolves around the production of glass transition to renewable fuels, moreover, of being sophisticated to implement as a prototype, the hydrogen gas nowadays is so expensive to use, thus there will not be a balance between the total cost and the efficiency. The rolling force model is the foundation of other rolling models. The related parameters include the work roll diameter, the friction coefficient, the entry/exit gages, the entry/exit tensile stresses, the material work hardening stress curve, and the mechanical and thermal properties of the roll and the strip. The force model can predict the feasibility of rolling, the rolling force, the rolling torque, the rolling energy, the normal, shear, and compressive stress distribution curves in the roll bite, the neutral point, and many other rolling parameters. As shown in Figure the roll bite is divided into the entry elastic deformation zone, the core plastic zone, and the exit elastic recovery zone. The rolling equation was proposed by von Karman in 1925 considering the force equilibrium condition of an infinitesimal element in the roll bite. The first one is the relationship between the shear stress and the normal stress, which was formulated by Coulomb's law of friction for the slip friction zone and assumed to be the constant shear yield stress for the stick friction zone. The roll gap thickness is the second equation using a partial circular arc of an equivalent roll diameter calculated by Hitchcock ™ or Hertzian equation *¥. The $C_{2c} \in [10(\eta - d_b)t_2, 10(\eta + d_b)t_2]$ material deformation criteria elastically and/or plastically came to the third equation. The elastic zones obeyed Hooke's law while the plastic zones were dominated by the von Mises yield criterion. This matrix is derived based on the equilibrium condition of the parameters. The 2* stage transport matrix derived from the beam deflection theory "*is a distance transport matrix from node B to node C. This matrix is used to consider the beam deflection between nodes B and C without any singular points (nodes with the spring and gap elements). The transport process starts from the left corner of the model (point 1) and stops at point m. The global transport matrix is then formed to correlate the parameter vectors of nodes 1 and m on only the rollability (achievable gage), but also the productivity and the marketability (achievable crown and shape). The determination of the roll size must consider not only the rollability (achievable gage) but also the productivity and the marketability (achievable crown and shape). The strip crown is calculated by the roll stack deflection model. There are many factors influencing the exit strip crown including the natural crown, the crown effects due to roll benders, the crown effects due to roll crowns, and the crown effect due to the entry crown. The basic

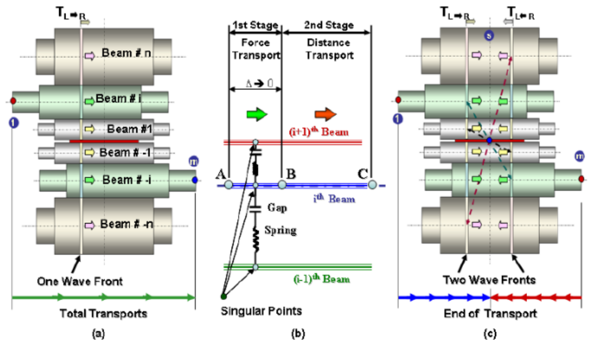


FIG 54

crown/shape control concept is that the strip shape will not change if the crown ratio difference is within the shape dead band ds. Hence, the target exit crown should be controlled within the following range: The work roll diameter determines the rolling feasibility.

FIG 55

The achievable minimum gage has a very strong relationship with the work roll diameter. The small work roll diameter can roll down to the thin gage. The general rule used in the industry for the minimum gage and the maximum pass reduction is also based on the work roll diameter. Besides the work roll diameter, other factors, such as the entry/exit tension, the friction coefficient, and the material property, have their contribution as well.

Recommendations:

After making our prototype we recommended points for the new researchers who would work on developing our project to put them into consideration:

- The first recommendation is to increase the thickness or the diameter of the axes to make the sheet thinner.
- The second recommendation is to use a piston to make all the copper sheets with the same dimensions.
- On large scale is to increase the power of the torque to endure 360 Newton of weight and to increase the heat to liquidate copper more quickly.
- Applying electrolysis on the wasted copper from the wires to release any impurities as some wires are not one hundred percent pure copper. These wires can have high resistance, but they can exist within the wasted wires.

To avoid reducing the efficiency of the copper sheet the electrolysis could be applied.

- Using the two-granite axis. The granite is heavy and can withstand high temperatures. Using the granite would make the copper sheet thinner and lighter.

Learning Outcomes:

Subject	LO	Connection
Mechanics	ME.2.06	Power and its law which is w/t and how to calculate the power of the motor to know its efficiency.
Physics	PH.2.09	RL, RC, and RLC circuits to understand the components and how the circuits in the electronic materials are connected, to calculate it's current and voltage, and to be able to connect the circuits of the feedback system correctly.
physics	PH.2.10	The DC motor and how it works help in understanding the motor mechanism of the manufacturing process.
Physics	PH.2.12	AC circuits to understand the circuits of the electronic boards. Impedance, rms, voltage, and current to make the calculations of the circuits in the feedback control system.
Math	MA.2.08	How to calculate the derivative which is the rate of change and it is equal to the slope at a point in the graph of the function. It helped a lot to calculate the changes in the output of the prototype.
Biology	BI.2.08	The positive and negative feedback systems of the reproductive hormones in the male and female helped in the feedback mechanism.

English	Cycle 4	Learning new vocabs. Learning about the argumentative essay helped in discussing opinion and counter-opinion. Writing portfolio and poster with right grammar and spelling, and with advanced words.
Chemistry	CH.2.09	Electrolysis and its application on battery. Helping in understanding the mechanism of the battery in the electronic circuits and its type.
Geology	ES.2.08	The subduction process and how nature reacts as a feedback system help in the deep understanding of the feedback system.
Computer science	CS.2.06	We learned about java coding which helped us in understanding the basics of coding that led to help us make the code of the feedback system better.

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