

## **Proposal Title**

**Production of biogas from organic waste: Using date palm waste as a model**

**Project number : (ASTP-09)**

### **ABSTRACT**

In this proposed research project, the technology of biogas production, which is a form of biotechnology application, will be used as means for organic waste treatment in the kingdom of Saudi Arabia. This application is supposed to help promote efforts of environment protection in the Kingdom through removal of organic wastes and reduction of the emission of greenhouse gases. Other deliverables include the production of renewable clean energy, soil fertilizers, and animal feed. A contribution to the establishment of bases for the development of biotechnology in the Kingdom is also another expected outcome of this application.

Experiments will be conducted to study the suitability of wastes from date palm tree for biogas production. Digesters will be designed and manufactured in the local market, a suitable production technology developed and optimized, biogas yields calculated and evaluated, and digestate analyzed to evaluate its potential uses as soil fertilizer and animal feed. Finally, a prototype pilot plant for biogas production will be built and operated as a demonstration unit.

The fermentation experiments will be conducted as follows: The feedstock will be date palm tree wastes. Alkali, acid and thermochemical pretreatments of the feedstock as well as use of additives will be tried to improve productivity. The operational parameters to be optimized will include temperature (mesophilic and thermophilic ranges), pH (at about 7), agitation (digester will contain a stirrer), Hydraulic retention time, organic loading rate, solid concentration (amount of fermentable material in the substrate, 70-90 g/l), and C:N ratio

(about 20-30:1). To start up fermentation on the digester will be seeded with cow dung, then backslapping .

Analysis and calculations will include the measurement of volume of biogas produced and digester temperature and pH during fermentation. The C:N ratio and the concentrations of total and volatile solids, sugars, and heavy metals in the feedstock and digestate and the concentration of methane and carbon dioxide in the biogas will be determined. The optimum organic loading rates and hydraulic retention times will be calculated on the basis of the daily feedstock additions, and volumetric methane production calculated as methane production per unit volume of reactor. The microbial content of the digester will be determined by cultivation on nutrient agar medium incubated in anaerobic jars

## **Proposal Title**

### **The Roles of Tourism in the Degradation of Ashgaygah Sand Dunes Area in Alqassim, KSA**

**Project number (09 – ENV919 – 08)**

## **ABSTRACT**

Protecting the natural environment from degradation especially in areas with sensitive ecological systems characterized by rare and low rain falls as well as low plant cover has been the focus of many countries around the world. Such areas in Saudi Arabia cannot tolerate negative human activities for a long. Growing tourism activities and urbanization are noticeable in Ashgaygah area in Alqassim region, KSA. This growth normally affects on the natural environment in different ways such as decreasing the vegetation cover and degrading the soil. In addition, human activities such as camping and touring by cars contribute to desertification (Al-Nafe 2007). Ashgaygah sand dunes area is a popular area which has seasonal tourism festivals twice a year. Associated activities with these festivals were usually uncontrolled as observed during several seasons. It has been observed that these annual festivals and other human activities including urban growth which developed

to support tourist activities in Ashgaygah area have lead to the destruction of its natural environment and hinder sustainable development of natural resources.

The aim of this study is to provide a clear picture of the current condition of natural environment at Ashgayagh and develop a model to conserve and rehabilitate the area taking into account the continuation of sustainable tourism. This including, assessing and analyzing the problems emerging from tourist activities and urbanization in Ashgaygah will be the focus of this study. In addition, the changes in the land use and land cover of Ashgaygah during the period between 1980 and 2009 will be investigated. Also, the role of human activities on damaging the environment components soil and seasonal and permanent plant will be highlighted. In addition, behaviors of tourists and visitors towards the environment will be identified. The study also, will seeks to propose a model for sustainable tourism in harmony with the sensitive environment. The spatial database will build by using ArcGIS desktop software to complete the spatial analysis and display the result by maps.

The study attempts to producing high accuracy digital maps and digital database to solve environment problems. This database and maps are utilized from modern technology satellite images and GIS. The database and maps accurately show the distribution and characteristics of vegetation and soil in detailed. Moreover, studying the topographical characteristics of Ashgaygah provides data about slop and sand dunes which have impacts on the land cover and tourism activities. Also, identification of species and plants communities prevailing in Ashgaygah will be provided and classified. The ways which can be taken to restrain the degradation on vegetation and soil in Ashgaygah environment and how to maintain it will be highlighted. Develop a model in order to protect the environment and managing human activities especially tourism. This model can be applied to similar areas in Saudi Arabia

## **Proposal Title**

# **A digital model for reconstructing and allocating the wadis systems within Riyadh metropolitan area and its relationships with the urban growth**

## **ABSTRACT**

With the rapid growth of Riyadh city, the wadi channels were removed and the direction of the flow was changed. Thus, the locations of these channels and the directions of the flow are desperately needed in the form of detailed digital maps with creating geodatabase using remotely sensed and GIS data.

The importance of the study is that the environmental contribution through an objective scientific analysis for the relationships between actual situation of urban growth of the Riyadh city on one hand and the old channels locations on the other are very important data for the decision makers especially in environmental crisis management. So this study aims to develop an integrated digital model using remote sensing and GIS to reconstruct and allocate the wadis systems within Riyadh metropolitan area and their interactions with the suggested urban growth II 1442H corresponding 2022.

## Proposal Title

# INDUSTRIAL WASTEWATER TREATMENT: ELIMINATION OF HEAVY METALS AND RADIOELEMENT ON ACTIVATED CARBON AND ALGAE

**Project number : (08-ENV429-8)**

## ABSTRACT

The industrial residues are considered as the main sources of hazardous pollutants such as heavy metals and radioelements. These industrial residues, especially liquid wastes are usually mixed with wastewater and ejected in nature. Therefore, they are mixed with either soil or groundwater that explains many poisoning cases and the spread of illness especially in the industrial countries.

All these factors prompted professionals in environment field to investigate the existence of solutions for the treatment of this industrial liquid waste before its disposal. There are various methods for removing heavy metals and radioelement including chemical precipitation, membrane filtration, ion exchange, liquid extraction and more advanced techniques such as reverse osmosis. However, these methods are not widely used due to their high cost and low feasibility for small-scale industries. In contrast, an adsorption technique is by far the most versatile and widely used. The most common adsorbent materials are activated carbon, alumina silica, metal hydroxides, and algae. As proved by many investigators, removal of heavy metals by activated carbon and alga is economically favourable and technically easier.

The overall object of this work is to provide an efficiency technology for the removal of heavy metals and radioactive element from industrial liquid wastes by an activated carbon which will be prepared and characterized and also by using a pre-treated sea alga. Many samples of industrial polluted water containing heavy metals ions and radioelements will be analysed and then treated. The characteristics of the so treated water should be compliant to the National and International Normalization and standard criteria of water.

Activated carbon, Alga, Industrial wastes, Heavy metals, Radioelements, Chemical , Chemical analysis, Thermodynamics, kinetics, Environment activation

## **Proposal Title**

**Sulphur Dioxide Pollution Control and Production of Gypsum and Fresh Water**

**Project number :** (10-ENV1358-08)

### **ABSTRACT**

This research proposal is designed to develop and demonstrate experimentally a new and improved Flue Gas Desulphurization (FGD) system using the rejected brine from the thermal or/ and reverse osmosis sea water desalination plants. The experimental data are necessary to carry out the process design of the proposed system. The process by-products are gypsum and fresh water. The duration of the project is 24 months and the required budget is 1,816,400.00SR.

Currently, the sulphur dioxide pollution is attracting a great deal of attention. This is mainly because of the serious negative effect of air pollution on the human life, plants, and animals. Acid rain presents a whole new set of problems for the environment, affecting lakes, trees and other forms of wildlife. The project is of vital importance for air pollution control in Saudi Arabia because there are about 77 power generation plants in operation. Most of the power generation plants are located on the Arabian Gulf (38 %) and on the Red sea (33 %). The fuel used to run these power generation units are mainly raw oil (20 %), diesel (22 %), fuel oil (13 %), and natural gas (45 %).

Moreover, there are other petroleum, petrochemicals, cement, aluminum and steel industries which burn extra huge amount of oil. It is worth mentioning that all the boilers in the dual purpose (water desalination and power generation) plants use the crude oil as the main fuel. The sulphur dioxide emission from these boiler is nearly 10 times the allowable emission standards.

The highly concentrated lime and limestone in the rejected brine from the desalination plants are capable to control the rate of sulphur dioxide emission from power plants and other industries. Moreover, they can remove other pollutants such as hydrogen chloride (HCl), sulfur trioxide (SO<sub>3</sub>), fine particulates and mercury. The use of the rejected brine from the different water desalination plants will reduce the amount of brine discharge back to the sea. This brine is about 7 million m<sup>3</sup> per day. It is estimated that the cost of the damage from sulfur dioxide varies between 0.3 to 1.6 cents per kWh. That is the cost of damage of sulfur dioxide in Saudi Arabia is about 0.76 to 1.43 million SAR per day and the capital cost for installing the required FGD systems is about 25 to 50 Billion SAR. The proposed system will reduce the cost by a very high percent.

A scaled down experimental unit will be designed, constructed and operated at different design and operating conditions. The flue gases will be simulated by an air and sulphur dioxide gases mixture. The concentration of the SO<sub>2</sub> in the mixture will be controlled according to the experimental conditions. In the first stage of the experiments, we will use a synthetic sea water instead of the brine. However, the bulk of the experiments will use rejected brine from the Al Khoper desalination plants. The expected output of the project

area:

1. Process design for an efficient and economical system for Flue Gas Desulphurization (FGD).
2. Experimental data necessary to carry out process design of a industrial scale unit.
3. Experimental data indicating the unit performance at different operating conditions.
4. Well designed, instrumented, and controlled experimental setup which can be used in any gas – liquid two phase flow.
5. Better understanding of the process of flue gas desulphurization by rejected brine from desalination plants.
6. Publish, at least, two paper in top ranked international peer refereed journals.

