Compact Fluorescent Lamps (CFLs) and Mercury
Frequently Asked Questions

Marine Water Quality Monitoring—Manifa Offshore Project
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The President Award for Environmental Stewardship</td>
</tr>
<tr>
<td>2</td>
<td>Innovative Marine Water Quality Monitoring for the Manifa Offshore Development Projects</td>
</tr>
<tr>
<td>4</td>
<td>Saudi Aramco’s Flaring Minimization Roadmap</td>
</tr>
<tr>
<td>7</td>
<td>Ergonomics - It’s more than just a chair!</td>
</tr>
<tr>
<td>12</td>
<td>EPD’s Groundwater Contaminant Monitoring Program: An Overview</td>
</tr>
<tr>
<td>15</td>
<td>Prevention of Food Borne Infections In Our Homes</td>
</tr>
<tr>
<td>17</td>
<td>Compact Fluorescent Lamps (CFLs) and Mercury</td>
</tr>
<tr>
<td>20</td>
<td>Noise: The Unwanted Sound</td>
</tr>
<tr>
<td>24</td>
<td>Oily Sludge Waste</td>
</tr>
<tr>
<td>27</td>
<td>EH&amp;S Module: Replacement for Legacy Waste Manifest System</td>
</tr>
<tr>
<td>30</td>
<td>Saudi Aramco Sponsors SAWEA Workshop</td>
</tr>
<tr>
<td>32</td>
<td>First Waste Management Technical Exchange Meeting</td>
</tr>
<tr>
<td>33</td>
<td>Environmental Events</td>
</tr>
</tbody>
</table>
The President’s Award for Environmental Stewardship

Three Saudi Aramco organizations were recognized on November 24, 2007 at the Plaza Conference Center for their environmental performance during 2006 at the annual President’s Award for Environmental Stewardship luncheon hosted by the Environmental Protection Department (EPD) under the sponsorship of President and CEO, Abdallah S. Jum’ah.

Representing a broad cross-section of operational areas, the awards’ recipients were the Shaybah Producing Department, the Southern Area Pipelines Department, and the Utilities Department.

Winners were honored for their environmental performance among 44 facilities and organizations ranked in 2006. Hesham A. Al-Musaid, EPD Manager, told an audience of corporate, executive and facilities management that the past year has seen significant improvement in reducing environmental impacts within Saudi Aramco organizations. “Although we are recognizing the three front-runners today, company organizations that exerted extra efforts to protect the environment are also winners,” Al-Musaid said.

Jum’ah spoke about the company’s environmental achievements and the challenges facing the oil industry, including tighter regulations and public perception. He also urged organizations to address environmental issues proactively and ensure that their operations do not adversely impact the environment.

The President’s Award, established in 2003, is based on the Facility Environmental Performance (FEP) system, developed by EPD to assess and rate each Saudi Aramco facility according to four environmental categories: compliance, performance, awareness and training, and initiatives. The final 2006 FEP scores were based on the Corporate Environmental Scorecard and other EPD data, as well as an evaluation of each facility’s environmental initiatives. Forty-four facilities were scored on criteria including air quality and air pollution, wastewater management, groundwater protection, oil spills, waste management, industrial hygiene and environmental awareness.

The award is aimed at promoting a sense of stewardship in environmental fields, recognizes organizations with outstanding performance in environmental protection, sets positive role models and provides an incentive for Saudi Aramco organizations to enhance their environmental performance.
Innovative Marine Water Quality Monitoring for the Manifa Offshore Development Project

The offshore development of the Manifa Field involves extensive dredging and reclamation for the new drilling islands and the causeway connecting them. Work by at least 2 dredgers and numerous support vessels began in March, 2007 and will continue until the end of 2009 when all 27 drilling islands are completed.
EPD has worked closely with the PMT for the Manifa project, environmental surveyors for Jan De Nul, the dredging contractor, and KFUPM to implement a program to minimize and monitor water quality impacts in relation to sensitive marine biotopes. Since excessive turbidity, caused by sedimentation and the related interference with light penetration in the water column, can have negative environmental impacts on marine flora and fauna, compliance monitoring with national and company standards is required.

While traditional water quality testing methods are employed that take discrete samples of water quality at the same locations each day and at distances down-current of dredging operations, there are inherent operational and long-term monitoring limitations to these methods. A more global, real-time, continuous sampling program was deemed necessary for the Manifa area because of the shallow, productive environment, and the length and scope of the construction project.

In order to provide an assessment of the water quality changes over a large area where operations are continuous (on a 24/7 basis), fixed marine water quality monitoring stations using specialized instrumentation were established. The monitors continuously measure and transmit data packets to an onshore datalogging system every 10 minutes. Sensors to measure turbidity, dissolved oxygen, pH, temperature, and salinity (as conductivity) are utilized at each station.

Additionally, in seagrass bed areas, photosynthetically active radiation sensors are employed to measure available light at the water surface and at 1 meter above the seabed in order to determine light penetration and the correlation with turbidity. Finally, the level of sedimentation in the lower water column is measured using sediment traps.

Although the water quality monitoring systems require vigilant calibration and maintenance due to the extreme conditions of the Arabian Gulf and the rapid bio-fouling, measurement data continue to be collected day and night to ensure action trends can be analyzed and correlations are made with other environmental and ecological parameters. This system assists scientists in remote sensing a wide area to detect perturbations in water quality and to help determine such relationships that may be weather-related or construction-related. Where it is found that changes in water quality are construction-related, appropriate operational controls are performed to protect sensitive marine habitats.
Introduction

A roadmap is developed by the Corporate Flaring Task Team to minimize daily flaring from new and existing Company facilities. Daily flaring is defined as the flaring of low volumes of purge gases introduced into flare headers to ensure no air ingress into these systems; plus the leakages from flare header isolation valves. This flaring does not refer to emergency flaring during plant upsets.

Background

Government (PME) environmental regulations require control of visible emissions from all industrial activities by reducing the opacity of the emissions to a maximum of 20%.
These standards apply only to routine emissions and not to emergency, start-up, or shut-down events. In compliance with these visible emissions regulations, most of the Company flares are now considered smokeless with only a few exceptions in SAOO, NAOO and SAGO. Capital projects had been initiated to convert these smoky flares to smokeless.

As a response to the escalating cost of these smokeless capital projects, the Corporate Flaring Task Team was commissioned in October 2005 and was tasked with the development of an overall corporate roadmap on flaring.

Other options besides smokeless flaring are being utilized regionally and internationally, and it was prudent to evaluate the applicability and economics of these alternatives. The Corporate Flaring Task Team began by asking a couple of pertinent questions:

1. Is smokeless flaring the best solution? and
2. What are others doing?

Worldwide Practices
At the World Summit on Sustainable Development held in Johannesburg in August 2002, a Standard for Gas Venting and Flaring Reduction was developed by an international partnership called the Global Gas Flaring Reduction (GGFR) partnership. This public and private partnership consists of representatives from the International Association of Oil and Gas Producers and the World Bank. To date, 10 major oil companies, the OPEC Secretariat, and 14 countries that contribute a significant share of the world’s total flaring (about 70%) have joined the GGFR partnership. Qatar is one of the latest members of the GGFR partnership whose membership also includes the United States, the European Union, Canada, the Russian Federation, Algeria, Nigeria, Indonesia, and others.

In 2005, a joint OPEC/World Bank Group Workshop was held on Gas Flaring Reduction. Examples were referenced of carbon credit claimed from flare gas recovery (FGR) projects carried out in Indonesia, Nigeria, and other developing countries.

Flare Gas Recovery
Flare gas recovery is a proven technology that is becoming the industry standard to recover flare gases from onshore and offshore facilities.

In a conventional set-up, the flare KO drum vapor goes into the flare header and then to the stack to be flared. Figure 1 shows an FGR system tying into the header downstream of the KO drum, and upstream of a liquid seal drum. It depicts a wet gas compressor, a typical application in FGR, with a water chiller and separator drum. Other system requirements include tie-ins to the plant control system, and a nitrogen purge unit if nitrogen is required to purge the flare header. This is one of several design options for this unit, and the best option needs to be identified on a case-by-case basis.

Currently, there is widespread implementation of FGR to minimize greenhouse gas emissions, recover valuable gas, and claim CO₂ tax credit. FGR projects have been initiated at Motiva refineries, a joint venture between Saudi Aramco and Shell and at Chevron, Statoil, Exxon Mobil, BP Amoco, Reliance of India, ADNOC, and Kuwaiti facilities. In addition, the oil majors have developed internal flare reduction standards that have resulted in the installation of FGR with each new project.
Figure 3 below shows a skid-mounted, semi-portable FGR unit.

Figure 3: An Envirocomb Skid-mounted FGR Unit

In Saudi Arabia, the value of the associated gas was recognized early on with the development of the Master Gas Plan in the 1980’s. The huge gas network created over the past three decades attests to this fact. Since the start-up of the Master Gas System, the regular daily flaring has been limited to flare header purge gas, daily leakages from flare header isolation valves, and any unusual operational requirements. In addition, the Company has begun to implement flaring minimization initiatives. Examples include:

- ‘Uthmaniyah Gas Plant — leaking isolation valves on the flare headers have been replaced with tight isolation valves.
- Shedgum Gas Plant — same as above.
- Southern Area Oil Operations — GOSP compressor reliability was substantially improved through rigorous maintenance programs.
- South Ghawar — an automated trip reporting system is used to track all flaring activities.

Flaring Minimization Roadmap

The roadmap developed by the Corporate Flaring Task Team and endorsed by Company management, calls for the implementation of several recommendations:

1. Develop guidelines to minimize daily flaring using:
   - flow meters on flare headers to accurately measure the low daily flaring rates
   - plant specific KPIs to track flaring rates and utilize best practices to report, control, and minimize daily flaring

2. Install FGR units on elevated flares with daily flaring rates, after implementation of flaring minimization, equal or greater than one million SCF per day (>1 MMSCFD).

3. Convert conventional flares with demonstrated low flaring rates (less than 1 MMSCFD) to smokeless to meet current environmental regulations.

Flare gas recovery provides the following:

- An economic incentive by recovering the flare gas valued at more than $2 / MMBtu
- Improved reliability of the main flare tip. Note that this is an important consideration for the larger diameter flares (such as those found in gas plants) that are prone to damage from operation at the low daily flaring rates. With FGR, the main flare is in a stand-by mode, which improves its reliability and life, and minimizes the recurring cost of flare tip replacement.
- Reduced air pollution with the elimination of emissions of SOX, NOX, & VOCs caused by combustion of the gas.
- Reduction of carbon dioxide emissions from a carbon management perspective.
- FGR meets our corporate strategies & objectives.

Work on the implementation of the Flaring Minimization Roadmap is in progress. To date, the following have been accomplished:

- Revised the flare standard (SAES-F-007) to reflect the roadmap.
- Completed studies to scope flare gas recovery projects at several of our larger facilities that have multiple flare systems, with the first FGR projects at the Shedgum and Uthmaniyah Gas Plants.
- Finalized the flaring reduction guidelines.
- Identified the most suitable flare header meters.

Upon implementation, the roadmap will minimize flaring in new as well as existing facilities by incorporating FGR units where applicable, including some facilities that were targeted to convert their flares to smokeless operation. Flaring will also be minimized through the development and issuance of flaring reduction guidelines that incorporate the following best practices:

- Reduce process upsets in the facilities by addressing repeated trip causes.
- Minimize leakage of flare header isolation valves by repairing or replacing valves.
- Upgrade flare header meters to monitor and control (minimize) flare header purge gas rates.
- Utilize nitrogen purge instead of fuel gas in the standby mode for main flares of staged flare systems.
- Develop facility KPIs to track and report flaring rates

Currently, both the Shedgum and Uthmaniyah Gas Plants are installing flare gas recovery units instead of converting their flares to smokeless.

Submitted by Ra’ed Husseini & Prasad Pantula, Process & Control Systems Dept.
Ergonomics
It’s more than just a chair!

Background

Ergonomics is more than just a chair; it is the interrelationship of many other work systems. Adopting a systematic approach assesses the dynamic relationships between the end user (worker), the work task, equipment, workspace, environment and the organization at large. A participatory approach ensures that all stakeholders gain ownership and are accountable for effective change in the development, implementation and evaluation stages of the program. Using this methodology insures that there is a significant impact at operational, tactical and strategic levels of the organization. Ultimately this will assist in using the current organization infrastructure to support and cascade ergonomic principles. Environmental, Health, & Safety (EH&S) Management programs should not be seen purely as compliance with regulatory associations (e.g., OSHA, EPA), instead should be embraced as a core business strategy that has significant return on investment, as well as fulfilling the moral obligation of keeping employees healthy and safe. Most importantly, a systematic participatory program can leverage organizations towards a competitive advantage.
Introduction
Generally, there is a misconception about what ergonomics really is, and how it can develop and sustain a functional, healthy, and productive workforce. In an attempt to spread the word on injury prevention and ergonomics, this article outlines the basics found in the following:

- The definition of ergonomics
- The principles of ergonomics
- The benefits of ergonomics
- The OSHA Ergonomic Standard
- Musculoskeletal disorders (MSDs)
- Systematic Ergonomic (SE) model
- The four point contact system
- The SE risk assessment form
- Conclusions.

The Definition of Ergonomics
Ergonomics is derived from the Greek words, ergo (means work) and nomics (means laws or rules) [1]. Therefore, Ergonomics means the laws of work or the science of fitting workplace conditions and job demands to the capabilities and limitations of the workers.

The Principles of Ergonomics
Ergonomics is an interdisciplinary science; it integrates the fields of psychology, engineering, anatomy, anthropometrics, physiology, biomechanics, and kinesiology [2]. The goal is to achieve the optimal fit between the work and worker that will optimize productivity and preserve the safety and health of the workforce.

The three key Ergonomic principles that EH&S professionals need to consider are:

1. Design the work and equipment to suit the 90 to 95 percentile range of workers (height and reaches) — not the average or above average person.
2. Allow “people” to do the work (cognitive, processing, analytical tasks) that they do well, while “machines” (heavy, physically demanding, monotonous tasks) do what they do well.
3. Use a team to participate in work task decisions (e.g. engineer, designer, project manager and the end user to change work and equipment to suit workers better) — a participatory approach.

Proactive ergonomics should occur at the design phase of work tasks, to identify potential risk factors that can lead to injuries. International experience has shown that many organizations do not practice this approach, and often set up an ergonomics program as a reactive approach to an epidemic of musculoskeletal disorders (MSDs).

Employee Benefits of Ergonomics
- Reduces unnecessary pain and suffering
- Ensures a supportive and healthy work environment
- Allows employees to understand the risks and hazards of the job, so as to learn to avoid them
- Decreases the risk of sustaining an injury at work
- Reduces stress and cognitive overload
- Employees learn how to do work tasks with more efficiency
- Employees understand how to adjust equipment and furniture to suit their own height, weight and physiology
- Employees learn how to keep energized while on the job
- Employees understand the warning signs of MSDs and how to prevent them
- The employee gains a sense of appreciation as valued human capital

Employer Benefits
Ergonomics benefits and protects the organization:

The return on investment (ROI) for ergonomic injury prevention programs has been well documented. An example is a fall protection program implementation reduced one employer’s accident costs by 96 percent from $4.25 to $0.18 per person hour. Implementation of an OSHA consultation program reduced losses at a forklift manufacturing operation from $70,000 to $7,000 per year [3, 4].

OSHA’s office of regulatory analysis states that companies that implement effective safety and health, injury prevention programs can expect a reduction of twenty percent or greater in injury and illness rate, and return of $4 to $6 for every $1 invested [5].
If organizations do not have an ergonomics program or policy, employees will be at high risk of injuries. Within the field of occupational safety and health, the term musculoskeletal disorders (MSDs) are used to categorize injuries that occur at work due to the poor management and adherence of the OSHA ergonomic standard. MSDs are injuries to the muscles, tendons, ligaments, joints, cartilage, nerves, blood vessels and intervertebral discs of the spine. The severity of these injuries vary from low grade inflammation to the extreme crippling disabling disorders affecting the spine, shoulders, arms, elbows, wrists and fingers [6], and repetitive strain disorders.

**OSHA Ergonomic Standard**
The OSHA Ergonomic Standard clearly outlines five action triggers that EH&S professionals should be aware of the following:

1. **Repetition**: If the same range of movement using the same muscles groups for greater than two hours per day. Also, if using a keyboard greater that four hours a day.
2. **Force**: If lifting an object greater than 34 kilograms, or pushing or pulling an object greater than nine kilograms, for greater than two hours per day.
3. **Posture**: If there is a repeated deviated body position which is statically loaded either in sitting or standing (with a bent neck, stooped lower back, bent wrists, arms above head) for greater than two hours.
4. **Contact stress**: If there is a situation where there is an application of contact with a body part for greater than ten times per day, for greater than two hours.
5. **Vibration**: There is risk of MSDA if hand tools are utilized with maximum vibration levels of four ms-1, for greater than two hours per day, or hand tools with moderate vibration levels of two ms-1 for greater than two hours [7].

Research however shows that both individual factors and psychosocial should be considered. Examples of individual factors include the link between elevated body mass index and carpal tunnel syndrome, or history of back pain and current episodes of low back pain. There is a need for further research into the psychosocial and individual factors effecting MSDs, and how these factors should be considered in the OSHA Ergonomic Standard.

**Systematic Ergonomics**
The World Health Organization (WHO) describes work related disorders as being multifactorial in origin, such that the work environment and performance of work contribute...
significantly to the cause or aggravation of the disorder, but personal characteristics, other environmental and socio-cultural factors usually play a role as risk factors as well [7]. Therefore, the most effective approach to an ergonomics program should be a systematic and participatory one [8]. The systematic framework that should be considered is the ergonomic onion [9] of Figure 1 below.

This model depicted in Figure 1, addresses the end user with the interface of the task, (the actual step by step work processes), equipment (tools, furniture, machinery etc), workspace (workstation, factory floor, vehicle, etc.), environment (temperature, noise, lighting, etc.), organization (policy, procedures, safety regulations, etc.). If this framework is not considered in ergonomic practice, then the true root cause may not be realized, which leads to further injuries and unresolved problems in the workplace [10].

This model reinforces the ideal that ergonomics is more than just a chair and that it requires analysis at each system level to achieve a successful root cause analysis.

**Four Point Contact Rule**
Within the systematic framework, a four-point contact system can assist in identifying key risk factors between the end user (employee) and the task and equipment.

1 - Eye connected to DSE  
2 - Hands connected to keyboard  
3 - Back connected into chair  
4 - Feet connected to floor

- Contact 1= eyes to windscreen & rear mirror  
- Contact 2= hands to steering wheel  
- Contact 3= spine to car chair  
- Contact 4= feet to pedals

This same process also applies to driving a car.
**Systematic Ergonomics Risk Assessment**


Adopting a systematic participatory ergonomic methodology, will greatly assist Saudi Aramco, prepare the workforce and technological advances in the future, as well as effectively manage and prevent MSDs and work related stress.

In the future, it will be organizations that take care of their most valuable asset, their employees, that will have a competitive advantage by having a high-performing, productive workforce.

So hopefully, when you next have a discussion about ergonomics, you’ll understand that it is more than just a chair!

**References**


Submitted by Samantha Horseman, SAMSO

**Conclusion**

In conclusion, success of a systematic approach to ergonomics is proven by the research, especially in large multinational companies.

Promising research in Saudi Aramco has also indicated positive results from a controlled interventional study based on a systematic participatory ergonomics program, finding a reduction of upper limb injuries, improved self-efficacy of preventive practices, and improved productivity.
It is recognized that groundwater resources in Saudi Arabia are very limited because rainfall and infiltration are very rare. As shown in Figure 1, the available useful aquifers are limited but mined extensively for drinking water as well as for agricultural and industrial purposes. In recognition of the value of this finite resource, Saudi Aramco has worked for decades to protect the groundwater aquifers from contamination and to carefully manage them so the aquifers are not depleted. The Groundwater Contaminant Monitoring Program was initiated by the Environmental Protection Department (EPD) to detect groundwater contamination and to recommend and implement clean-up operations where technically and economically feasible.
In the early days of the Company, only wastewater and drinking water were monitored for public health reasons. Saudi Aramco did not have a monitoring program for untapped aquifers lying beneath its major industrial facilities.

Saudi Aramco’s commitment to groundwater protection caused it to form a Water Quality Committee in the early 1980s. This committee was assembled to coordinate the development of a Company-wide water quality monitoring program.

In the mid-1980s, Saudi Aramco initiated groundwater contaminant investigations according to internal standards. Groundwater contaminant monitoring wells were installed at a select number of sanitary landfills and on-land wastewater land disposal sites. In addition, groundwater contaminant monitoring wells were drilled at many of Saudi Aramco’s hazardous materials storage, and disposal sites.

In 1992, Saudi Aramco expanded its efforts to protect groundwater by fully implementing the Groundwater Contaminant Monitoring Program (GCMP).
The GCMP has the following goals:

- To protect the aquifers that lie beneath Saudi Aramco facilities from surficial contamination.
- To protect the marine environment from contaminated groundwater flowing from beneath Saudi Aramco’s coastal facilities.
- To expand the awareness of Saudi Aramco personnel about the need to protect groundwater resources.
- Reporting annually on the progress of the GCMP

EPD is achieving these goals by:

- Analyzing the quality of groundwater beneath Saudi Aramco facilities with samples from existing monitoring wells.
- Installing monitoring wells at Company facilities that are not currently monitored, and evaluating groundwater samples.
- Implementing remedial measures for contaminant plumes that threaten groundwater resources or the marine environment.
- Conducting educational and awareness presentations on groundwater issues for Company employees.

The GCMP satisfies the intent of Saudi Aramco’s environmental policy statement (INT-5) which states that:

“The Company will assure that its operations do not create undue risks to the environment or public health, and will conduct its operations with full concern for the protection of the land, air and water from harmful pollution.”

To-date, EPD has installed over 400 groundwater monitoring wells at 44 company sites as shown in Figure 2 below. These monitored sites were selected due to their facility operational nature, relatively shallow depth of groundwater, and the potential to impact onsite or offsite receptors (e.g., employee, neighbors, and/or marine life). Over 2,500 groundwater samples have been collected from these wells since the program began. The samples have been tested for volatile organic compounds, heavy metals, and other indicators of environmental pollution.

Figure 2: Groundwater monitoring sites.

Submitted by Mansor A. Kashir, EPD
A food borne infection is an illness caused by consuming food such as meat, poultry, fish, eggs, or even raw milk that are contaminated with bacteria, viruses, chemicals, or the toxins produced by the bacteria. The contaminated food may look, taste, and even smell normal but can be loaded with any of these contaminants. The symptoms of the illness may include abdominal pain or cramps, nausea, vomiting or diarrhea, fever, headache, sweating, and even dehydration.

Food borne infections are very common and although most of them go undiagnosed and unreported, there is still a large number of reported cases every year that are, in some instances, very serious and sometimes even fatal.

Home is one of the most common places where food born infections can occur. There are many ways that food can become contaminated in the home. People can become infected by touching an animal or working in the garden and coming in contact with contaminated soil or untreated water. Infected people who sneeze or touch food with unwashed hands then transfer the bacteria or viruses to the food items. Unless the food is then properly cooked, the bacteria or viruses will remain active.
So, how can we prevent food borne infections?

1. First, wash your hands and maintain good personal hygiene. This will help prevent the direct transfer of bacteria and viruses to food items especially if you always remember to wash your hands before preparing food, after handling raw food, using the toilet, or touching pets.

2. Secondly, prepare foods properly. Use separate work surfaces and utensils for preparing raw food and cooked food. All work items should be cleaned and disinfected properly after use, and vegetables and fruits should be thoroughly rinsed in clean running water.

3. Third, cook food properly. Defrost food completely before cooking unless the defrosting is part of the cooking process. Follow the cooking instructions carefully for the required temperatures and times of various foods, and remember to preheat the oven accordingly. Cook all meat and poultry adequately and do not cook food too far in advance of the meal.

4. Finally, store foods properly. Make sure to refrigerate all leftovers at no higher than 5°C; and do not store food at room temperature. If you freeze an item, make sure the freezer section is set to a temperature of -18°C or lower. Make sure that raw foods are not stored above ready-to-eat food in the refrigerator and always cover raw food. It has been shown that the use of leftovers is a major contributing factor to the incidence of food borne infections. So use small containers and cool hot foods at room temperature before refrigeration. Also, reheat leftovers thoroughly at high temperatures and do not reheat foods more than once.

Submitted by Alaa M. Al-Jahdali, Environmental Compliance Division / EPD
Compact Fluorescent Lamps (CFLs) and Mercury

Frequently Asked Questions

Many of us are now using compact fluorescent lamps (CFLs) in our houses to save energy and contribute to a more sustainable lifestyle. It is a well-known fact that traditional incandescent bulbs are very energy inefficient by wasting over 90% of the electricity to heat. CFLs, on the other hand, use up to 75% less energy. Although CFLs do a good job in saving energy, there are some health and safety related concerns regarding handling the broken fragments of CFLs, should they shatter, or, to a lesser extent, the disposal of broken or spent CFLs. The following questions and answers will help to address the concerns and issues regarding these compact fluorescent lamps.

What are Compact Fluorescent Lamps?

Compact fluorescent lamps or CFLs are small fluorescent lamps that fit into standard light sockets. They are usually referred to as energy saving light bulbs because they use less energy than traditional incandescent light bulbs by converting electricity into light more efficiently. CFLs are also much more cost effective because they can last up to 10 times longer.
Do CFLs contain mercury?
Yes because they need mercury to generate visible light. The mercury is used to produce ultraviolet light, which, in turn, is changed into visible light by a special coating in the lamp. The amount of mercury in the CFL glass tubing is very small however, only about 4 milligrams or just enough to cover the tip of a ball point pen and just enough to last the expected lifetime of the lamp. By comparison, a typical mercury barometer may contain 100 to 600 grams of mercury or about 25,000 to 150,000 times the amount found in a CFL.

What is mercury?
Mercury, a toxic metal, is a naturally occurring element that is found in air, water and soil. Mercury is also released into the environment from many sources. It becomes airborne when rocks erode, volcanoes erupt, and soil decomposes. Mercury then circulates in the atmosphere and is redistributed throughout the environment. Mercury is used in thermometers, dental fillings, batteries, fluorescent light bulbs, and some electrical switches. Mercury salts are sometimes used as antiseptic creams and ointments. At room temperature, exposed elemental mercury can evaporate to become an invisible, odorless, and toxic vapor.

What are the health risks of mercury?
Exposure to high levels of mercury poses many serious health risks, including permanent brain, kidney and nerve damage. Mercury poisoning causes a decreased ability to see, hear, talk, and walk. It can cause memory, vision, and hearing problems as well as depression, irritability, nervousness, and the inability to concentrate. Mercury is a particularly serious problem for pregnant women and children.

Does the mercury in CFLs pose a risk?
The mercury cannot escape from an intact lamp and, even if the lamp should be broken, the small amount of mercury contained in a single CFL will most likely not cause any immediate harm. It should be noted that CFLs are often coated with plastic as a protector and, as they are of a smaller diameter than traditional bulbs, they are more durable and less prone to breakage. According to trade figures, CFL breakage rates are less than 1% but it still makes sense to avoid unnecessary contact with mercury; and any light bulb, broken or intact, should be dealt with sensibly.

How should I deal with a broken CFL?
Although the accidental breakage of a lamp is unlikely to cause any health problems, it’s always good practice to minimize any unnecessary exposure to mercury, as well as the risk of cuts from glass fragments. However, in the event of a CFL breaking on a floor:

1. Open a window and leave the room for at least 15 minutes.
   • Do not use a vacuum or broom to clean up the broken bulb on hard surfaces
2. Carefully scoop up the fragments and powder with stiff paper or cardboard and place them in a sealed plastic bag.
   • Use disposable rubber gloves, if available, or make sure to not touch the material with your bare hands. Wipe the area clean with damp paper towels or disposable wet wipes and then place them in the plastic bag.
3. Place all cleanup materials in a second sealed plastic bag.
   • Place the first bag in a second sealed plastic bag and put it in the outdoor trash container or in another outdoor protected area for the next normal trash disposal.
   (Saudi Aramco Reclamation and Material Disposal Unit (Tel. 876-3455) has storage facilities for disposal of such items.)
4. Thoroughly wash your hands after disposing of the bag.

If a CFL breaks on a rug or carpet, carefully remove the rug, if possible, to outdoors and then:

1. Remove all materials first without using a vacuum cleaner by following the steps above. Sticky tape (such as duct tape) can be used to pick up small pieces and any powder.
2. After all visible materials have been removed, vacuum the area where the bulb was broken. If on a carpet that cannot be removed, try to vacuum in a well-ventilated area by opening windows and doors to avoid breathing any vacuum exhaust that could contain small amounts of the material.
3. Remove the vacuum bag (or empty and wipe the canister) and put the bag or vacuum debris in sealed plastic bag(s) in the outdoor trash or protected outdoor location for normal disposal.

4. Again, thoroughly wash your hands after disposing of the bag(s).

Do not put the bag in a normal household dustbin.

The following sources were used to compile information for this article. For further information on this subject, please refer to these links:

- http://capecodextension.com/pdfs/Mercury%20in%20CFLs-%20EPA.pdf
- http://www.epa.gov/mercury/spills/index.htm#flourescent
- http://www.atrdr.cdc.gov/tfacts46.html#bookmark05
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- http://www.cdphe.state.co.us/hm/mercury/cflfactsheet.pdf
**What is Noise?**

Noise may be simply defined as an unwanted sound; however, an unwanted sound to one person may be pleasant to another. For example, loud music next door could be unwanted by someone trying to sleep while enjoyable to the ones partying. Whether noise is desirable or not depends on the circumstances. Sound is a pressure wave in the air that causes oscillations and vibratory movement of molecules. The sound level is measured in decibels (dB). A decibel is basically a unit of measurement that converts sound pressure to a more manageable logarithmic scale.

**The Hearing System**

Hearing is one of our five senses and enables us to recognize and respond to different sounds around us. A normal person can hear sounds in the frequency range of 20 to 20,000 Hz. The human ear consists of three parts: the outer ear, middle, and inner ears (Figure 1). The outer ear consists of the external part (the pinna) and the auditory canal (ear canal). The pinna collects the sound waves and modifies them by either amplifying certain frequencies or attenuating others. These sound waves then progress to the middle ear via the ear canal. The middle ear contains four main parts: the
eardrum (tympanic membrane), the hammer (malleus), the anvil (incus), and the stirrup (stapes). In the middle ear, sound waves cause the eardrum to move which, in turn, moves the hammer and anvil to push and pull the stirrup through the inner ear’s round entrance window. Thus, the stirrup or stapes converts the motion of the eardrum back into sound waves in the fluid-filled inner ear. The inner ear looks like a snail-like structure called the cochlea. The cochlea contains sensory hair cells submersed in a fluid. When sound waves pass through the hair cells, the cells move and generate nerve impulses that are transmitted to the brain. The brain, in turn, translates them into recognizable sounds.

Figure 1: Anatomy of the human ear. (Source: Diamond Environmental Ltd).
Hearing Loss Decreases
Hearing levels change throughout an individual’s life because of many factors. Some of these factors are occupational; others are not. Studies have shown that a human’s hearing decreases an average of about 0.5 dB(A) per year after the age of forty.

It is known that exposure to excessive noise can lead to hearing loss. The particular effects and the extent of the loss depend upon a number of things including the type of noise, its intensity, the duration of exposure, etc. Noise exposure however is not the only cause of hearing loss. Other causes called conductive hearing losses can be congenital hearing loss, accumulation of wax in the ear canal, physical damage to the ear drum, and inflammation or infection of the middle or inner ears. In general, hearing loss caused by exposure to high levels of noise is called noise-induced hearing loss or NIHL. NIHL reduces hearing by causing damage to the inner ear and its hair cells. When a person is exposed to high noise levels for a short period, he/she may experience a short-term hearing loss known as “temporary threshold shift” which is basically neural fatigue in the inner ears. In this type of hearing loss, the hearing level is temporarily reduced for a few hours or days. Therefore, it is recommended that a person not be exposed to noise for at least forty-eight hours before undergoing a hearing test or audiogram. If people are exposed to high levels of noise for too long, they may experience permanent hearing loss caused by irreversible damage to the hair cells and/or nerves. This type of hearing loss is known as Sensorineural Loss and it cannot be repaired. Some Sensorineural hearing losses are accompanied by a continuously heard sound described as a hum, a buzz, or a whistle that becomes much clearer during the nighttime or when it is quiet. When people are exposed to a very loud and sudden intense noise such as an explosion or gunshot, they may develop what is called Acoustic Trauma. Acoustic Trauma can be a temporary hearing loss if there is reparable damage in the middle ear or it can be Sensorineural if permanent damage has occurred to the hair cells of the inner ear.

A job-created hearing loss is usually identified during routine audiograms and is characterized by a drop in the frequency range of about 2,000 to 4,000 Hz. In contrast, age-related hearing loss shows a gradual hearing decrease (Figure 2).

Hearing Protection
The first way to protect hearing is to eliminate noise sources. For the workplace, noise can be managed by replacing loud machines with quieter ones, applying engineering controls (e.g. changing processes, installing acoustic insulation), applying administrative controls (e.g. reducing noise exposure time via job rotations) or utilizing personal protective equipment or PPE (e.g. ear plugs/muffs). (Figure 3).
Saudi Aramco applies the SAES-A-105 noise control standard to control high-level noise in the work environment. All high-level noise work environments are frequently measured and monitored by EPD Industrial Hygienists.

The Industrial Hygienist also assesses personal noise exposures and refers all potentially exposed employees to Occupational Medicine for periodical hearing tests as a part of the Hearing Conservation Program (HCP). The HCP ensures employees are protected and that no hearing damages have occurred due to high noise exposures. The HCP is a collaborative program between EPD and Occupational Medicine designed to determine the level of risks to the health of employees in Saudi Aramco.

Saudi Aramco adapts and applies the most stringent noise exposure standards worldwide. These standards include those established by the US Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygiene (ACGIH).

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Submitted by Ahmed R. Al-Yami, EPD
Oily sludge is defined as predominantly an emulsion of water and oil with napthalenic (polycyclic aromatic hydrocarbons), waxes, and other fine solids present.

Some Sources of Oily Sludges Wastes at Saudi Aramco:

- **T&I Wastewaters:**
  Waste discharges from Testing and Inspection (T & I) activities carry a lot of sludges residuals that end up in the industrial wastewater treatment plants.

- **Tank bottoms:**
  Tank bottoms are considered as one of the major sources of oily sludge resulting from T&I activities at Saudi Aramco. T & I for tanks are generally conducted every 10 years.

- **API separator sludges:**
  Sludge accumulated from industrial wastewater treatment plants especially those at GOSPs and refineries.

- **Off-specification products:**
  During upset situations, off-specification streams are diverted to industrial wastewater treatment plants where sludge residuals will be produced.

- **Sludge from a Slop Oil System:**
  Oily sludge that has been collected from industrial wastewater treatment plants by means of API separators and dissolved gas floatation units. This type of oily sludge is collected in hoppers and tanks for re-use.

- **Legacy wastes (in impoundments):**
  Wastes from old facilities that have inherited impoundments where the oily sludge has been stored for an indefinite amount of time and with time has become weathered and difficult to recover.
The main impact of oily sludge on the environment is the potential for groundwater contamination if the oily sludge is left untreated and exposed to the ground especially if the groundwater level is shallow (less than 30 meters). Also, oily sludge waste left in the vicinity of the marine environment can contaminate the coastal waters.

In the past, oily sludge has been either landfilled or incinerated. However, the difficulty of finding suitable landfill sites, the risk of groundwater contamination, and the high cost of incineration have combined to reduce the acceptability of either of these methods for the disposal of oily sludge.

Current Saudi Aramco regulations state that waste oils/water, hydrocarbons/water mixtures, and emulsions are classified as hazardous waste.

The Saudi Aramco General Instruction GI 430.001 “Waste Management” governs all types of waste including oily sludge. This GI states that oily sludges shall be disposed of immediately after generation. If logistics prevent the immediate transport to disposal facilities, storage is allowed for a maximum of 90 days. Therefore, it is important that such waste is properly treated and disposed of in a timely manner.

Additionally, the recently introduced government General Environmental Regulations (GER) require all hazardous waste management facilities that store such waste for more than three (3) months to be subject to numerous stringent inspections and monitoring & reporting requirements.

EPD has investigated many different methods and procedures for the proper management of oily sludge wastes and continues to look at new technologies. Some of these methods, procedures, and technologies include:

1. Source reduction techniques that involve the use of in-tank mixers, tank-cleaning methods, good housekeeping practices, and waste segregation procedures.
2. Recycling of oily wastes using physical phase separation techniques such as centrifugation, use as feedstock in the manufacture of waterproofing and construction materials, in road construction, and as a fuel in cement kilns.
3. Thermal desorption techniques for the recovery of the volatile hydrocarbons.
4. Treatment (with no recovery of hydrocarbon value) using landfarming techniques, bioreactors, and incineration.
5. Disposal (with no recovery of hydrocarbon value) using lined impoundments (pits and ponds)

EPD’s continuing efforts to minimize the generation of oily sludge waste include the following activities:

**Oily Pits Surveys**
EPD conducts site surveys at industrial facilities to determine the presence of oily pits versus what has been reported.

**Waste Minimization Opportunities**
This activity is conducted as per SAEP-1661 on all new facilities and facilities that have undergone a major expansion. An EPD team conducts a detailed survey of the facility to determine how to best minimize the waste generated, and how to recycle or recover value from as much of the waste as possible.

**Waste Manifesting**
Manifesting of solid and hazardous waste streams is a requirement as per Section 6 of the GI 430.001. In the past, operating facilities and their waste handling contractors had to do the manifesting manually using a multi-part “Waste Manifest” form. As of May 1, 2006, however, the manual system has been replaced with the online SAP EH&S system.

This system is helping EPD and the facilities to develop better strategies for waste management and economical recycling opportunities.

**Environmental Performance Assessment (EPA)**

This is an environmental audit program that EPD conducts at all Saudi Aramco industrial facilities. Environmental concerns that include the discharges of waste including oily sludge from a facility are documented and reported. Facilities are alerted of any improper discharge or storage of oily sludge during the inspection visit and given EPA finding. Each EPA finding is tracked and kept open until the facility properly addresses the problem. Facilities that do not close their EPA findings in a timely manner can be penalized by receiving a lower Facility Environmental Performance (FEP) score. The score determines the overall environmental performance ranking of the facility among other Company facilities.

Submitted by: Tamim A. Al-Buraikan & Thamer S. Mutairi, EPD
SAP EH&S Module: Replacement for Legacy Waste Manifest System

**Background**

The Saudi Aramco Waste Manifest System was designed to seamlessly track solid and hazardous waste from the time it left the facility where it was generated to the time it reached its final treatment and disposal. The system allows the waste generator to verify that its waste has been properly delivered and that no waste has been lost in the process.

In early 2006, the SAP EH&S “Environment, Health, & Safety” system was introduced Company-wide. The module used for this new SAP EH&S system includes many sub-modules to replace the legacy, paper-based Environmental, Medical, and Safety systems with an electronic online system. The SAP EH&S Waste Manifest module is one of these modules that replaces the paper-based “Waste Manifest, SA-9564” legacy system.
The key component of the legacy system is the Saudi Aramco “Waste Manifest” Form 9564 prepared by all generators who transport, or offer for transport, hazardous waste for off-site treatment, recycling, storage, or disposal. This is a paper-based document containing multiple copies of a single form. When completed, it contains information on the type and quantity of the waste transported, instructions for handling the waste, and signatures of all parties involved in the disposal process. The waste generator, the transporter, and the receiver (i.e., the treatment, storage, or disposal facility) must each sign the manifest when they take custody of the waste and retain a copy for their records. This system ensured accountability in all aspects of the transportation and disposal processes. Once the waste reaches its final destination, the receiving facility would return a signed copy of the manifest to the generator confirming that the waste was received by the designated facility.

As of May 2006, this legacy system was discontinued and hard copies no longer accepted by EPD.

Why have a Waste Manifest System?

Thorough and proper manifesting of all hazardous waste generated by facilities is a must for several reasons including, but not limited to the following:

- It is a requirement under the Government General Regulations. (Note that Hazardous and industrial wastes originated from or being shipped to the Royal Commission (RC) areas of Yanbu’ and Jubail shall comply with the Royal Commission requirements using the RC Waste manifest in addition to the SAP EH&S).
- It is required by the Saudi Aramco General Instruction 430.001 “Waste Management.”
- The waste generator is accountable for the ultimate fate of waste and therefore full manifesting ensures the waste is properly treated and disposed of at the intended facility.
- It helps to avoid liability issues.
- Accurate records of wastes and its types are essential for EPD to introduce the right technologies to minimize, recycle, and properly manage these waste streams.
How is the new system better?

The new SAP EH&S Waste Manifest system contains basic information (waste generator, transporter, receiver and waste type), is user-friendly and takes the waste manifesting parties only several minutes to complete.

The SAP EH&S has several main advantages and benefits over the legacy system. These include the following:

- **Replaces all paper forms.**
- **Helps waste generators and the Saudi Aramco Material Supply organization to manage and track the processing and disposal of waste material and substances in real-time.**
- **Provides quick access to the waste inventory of the generator.**
- **Provides quick reporting compared to the review of hard copies of waste manifest forms stored in scattered locations.**
- **Helps EPD comply with the Company’s Environmental Policy.**
- **Helps streamline various environmental assessment programs by providing EPD with on-line traceability and accountability of issued recommendations.**

Conclusions

The above-mentioned benefits can only be realized if waste generators and operating facilities use the SAP EH&S system and properly and thoroughly complete the online forms.

Submitted by: Nassir T. Al-Harbi & Alfredo C. Bautista, EPD
Saudi Aramco's commitment to water conservation and reuse has been extended beyond its own operations to the local communities through employee efforts in Company sponsored self-directed groups.

One of these groups is the local chapter of the Water Environment Federation (WEF) called the Saudi Arabian Water Environment Association or SAWEA. This local chapter has grown in size to become one of the largest international chapters of WEF. Since its creation in 2004, SAWEA has held five free-to-the-public workshops on water and wastewater topics.

The latest SAWEA workshop entitled “Project Management of Innovative Water and Wastewater Technologies” was held in early December 2007 in Al-Khobar and was sponsored by Saudi Aramco with support from the Saudi Arabian Ministry of Water and Electricity.

Over 500 local and international delegates attended the three-day workshop that was marked by the participation of a number of key speakers including His Excellency Abdullah Al-Hussayen, Minister of Water & Electricity, and Abdulaziz Al-Khayyal, Senior Vice President of Saudi Aramco Industrial Relations.

In his speech, the Minister spoke about the situation with water in Saudi Arabia and the more than 1300 water and wastewater projects carried by his Ministry. Currently, 30 desalination plants in the Kingdom produce 30 million cubic meters of desalinated water every day. Potable water production is 5.5 million cubic meters per day and it is projected that demand for potable water will increase to over 11 million cubic meters per day within the next 20 years.

The Minister further added that the Kingdom is producing over 20 million cubic meters of wastewater each day and the use of tertiary treatment will increase the collection and treatment of wastewater to more than 5 million cubic meters over the next 5 years.

Mr. Al-Khayyal talked about Saudi Aramco’s commitments to increasing the reuse of wastewater. The Company has spent over $5 billion over the past 30 years on water and wastewater projects. Saudi Aramco is presently producing 24 million gallons of industrial wastewater and 21 million gallons of sanitary wastewater each day. The Company is currently reclaiming and reusing over 20 million gallons of wastewater per day or almost 50% of the total amount of wastewater generated each day. Reuse applications include landscape irrigation, sod farming, cooling towers, boiler feed water.
Saudi Aramco is planning to complete various industrial water and wastewater projects costing over $750 million, and several community water and wastewater projects estimated at over $200 million. These planned projects will ultimately increase wastewater reuse to over 90%.

These projects include innovative technologies such as Ceramic Pressure Exchangers for reverse osmosis plants and Membrane Biological Reactors (MBR) for wastewater treatment. The Ceramic Pressure Exchanger recovers 30-50% of the energy required of reverse osmosis while the MBRs provide superior effluent reuse.

The workshop provided specialized training to the attendees on some of the most advanced water wastewater technologies currently available, and it brought many different groups together forming a network of water professionals to improve water and wastewater treatment technologies in Saudi Arabia.
EPD organized and hosted the first Waste Management Technical Exchange Meeting (WMTEM) on November 10-11, 2007 at the R&D Technical Exchange Center in Dhahran.

Over 230 professionals from around the world attended the meeting. Participants included waste management specialists, environmental experts, academia, researchers from national universities, government representatives, private consultants & contractors, and Saudi Aramco personnel involved in industrial waste management.

Internationally recognized experts from Europe, North America, and Saudi Aramco presented eighteen papers in the field of industrial waste management. The presentations covered aspects of industrial waste management that included regulations, recycling and reuse alternatives, the role of cement plants in reducing waste by waste co-processing, thermal centrifugation, and bioremediation.

The theme of the meeting was “Innovative Solutions to Recover Value from Industrial Waste.” The meeting was organized to:

- Create a platform to allow industrial representatives, technology developers, and environmental specialists to share knowledge, experience, and viewpoints regarding waste management.
- Enhance the awareness of industrial waste management and its related fields and disciplines, and
- Provide an opportunity to present and share industrial waste management technologies and their applications.

A key objective of the meeting was to identify promising technologies to reduce and recover value from wastes. A second goal was to promote synergies between Saudi Aramco and other industries to best manage reusable wastes. Both objectives were met with attendees exposed to many technologies that provided a better understanding of the environmentally friendly and cost-effective waste management options available.

Submitted by: Mohammad Dhafiri, Nassir T. Al-Harbi, and Nawi Al-Anazi, EPD
2007 Environmental Stewardship Workshop

As part of its continuing efforts to enhance the corporate environmental performance toward environmental excellence, EPD conducted an Environmental Stewardship Workshop (ESW) in early November 2007 in Dhahran. The primary objectives of the workshop were to enhance environmental awareness among the participants, encourage environmental stewardship, equip participants with sufficient information to proactively recognize potential environmental problems and risks, encourage full implementation of the Corporate Environmental Protection Policy & GIs, and to motivate participants to enhance facility environmental performance. In attendance were mid-level management including division heads and unit heads from a wide range of Company organizations. Topics covered at the workshop ranged from the Corporate Environmental Management System, Air Emissions, Wastewater Management, Marine Protection, Groundwater Protection, and Occupational & Environmental Health Management to Radiation Protection and Environmental Performance Assessment. To-date over 85 mid-level management personnel have successfully participated in these Environmental Stewardship workshops.

Environmental Awareness Program at Saudi Aramco Exhibit

EPD participated in the Summer 2007 activities of the Saudi Aramco Exhibit by promoting environmental awareness for the Exhibit visitors to ultimately create an environmentally responsible culture among the general public. To meet this goal, EPD developed a comprehensive Environmental Awareness program consisting of displaying literatures, films, and presentations that tackle issues and concerns of Environmental Health such as food safety, biological pollution, and other environmental matters. This summer program started on July 1, 2007, and continued through August 2, 2007, with over 80,000 people visiting the Exhibit during the one-month summer activities. Furthermore, more than 2000 copies of booklets and flyers were distributed daily and a presentation on “Household Chemicals” was given twice weekly to the visitors.
Environmental Education Program Workshops

The latest EPD Environmental Awareness initiative, Environmental Education Program, was launched in December 2007 through a series of train-the-trainer workshops attended by more than 50 teachers from various schools in the Eastern Province (EP). The program has been developed in cooperation with the EP Directorate of Education and aims to enhance environmental knowledge and awareness amongst young generations as a reflection of company social responsibility and corporate values of “citizenship” and “stewardship”.

Teachers participating in the workshop received an environmental educational kit that included teacher guide book, various environmental multimedia CDs, environmental books, brochures, posters and other publications. The participants will use the materials provided and other environmental activities such as campaigns, exhibits, and competitions to propagate the knowledge gained at these workshops throughout their respective schools.

‘Uthmaniyah Gas Plant Environmental Awareness Campaign

As part of ‘Uthmaniyah Gas Plant (UGP) initiatives supporting the corporate “citizenship” and “stewardship” values, a 2-day environmental awareness campaign and exhibit covering Saudi Aramco Southern Area was conducted in ‘Udhailiyah in December 2007. Visitors included executive management and employees from UGP, SA Gas Operations, SA Oil Operations, ‘Udhailiyah Industrial Training Center (ITC) as well as the residents of ‘Udhailiyah Camp and students from ‘Udhailiyah Public Schools. In addition to company organizations, local contractors participated in the campaign by exhibiting products and demonstrating their services. Thousands of booklets, posters and other environmentally related items were distributed to the visitors.

Environmental Education Program Workshops
The Environmental Education program is expected to create a positive attitude towards the environment, illustrate the positive and best practices to prevent or reduce environmental pollution, and to foster attitudes, motivations, and commitments to take personal responsibility for environmental protection.

**World Environment Day**

EPD and several Saudi Aramco organizations teamed up with contractors, volunteers, the government, and professional societies to present an eight-day educational exhibit in June 2007 on the occasion of World Environment Day. The exhibit, with a theme of “Technologies to Protect the Environment” included technologies that have been utilized by Saudi Aramco in the field of air quality, wastewater management, oil spill response, energy efficiency, contaminated soil remediation, and workplace protection. Displays demonstrated the Company’s commitment to preserving the environment and how community residents can contribute to a better environmental quality at home.

Laser-based Oil Fingerprinting technology that won the 2006 National Companies Forum award, the Low-Temperature Oxidation method for treating contaminated soils without excavation, and the AMMNET station attracted much interest. The Marine Department showed off its latest capabilities and presented an exhibit where visitors could watch an actual underwater dive and view some of the oil spill response equipment the company maintains in case of accidents.

The Marine Directorate of the Ministry of Agriculture presented displays ranging from mangrove preservation efforts to the Kingdom’s bustling fishing industry that depends on a clean Arabian Gulf to provide food to homes across the region.

The exhibit was also visited by a group of Opinion Leaders who were impressed by the technologies displayed and the efforts exerted by the company in protecting the environment.
Handling Chemicals at Home