EVALUATION OF EXISTING ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) IN ATTOCK OIL REFINERY

Ambreen Mahmood [1], Khalida Khan [2], Akif Rahim[3], Amina Akif [4]

[1] College of Earth and Eviormantal Studies, University of the Punjab, Lahore, Pakistan
[2] Director of Centre of Integrated Mountain Research, University of the Punjab, Lahore, Pakistan
[3] Centre of Integrated Mountain Research, University of the Punjab, Lahore, Pakistan
[1]Corresponding Author: Email: ambreen.cees92@gmail.com.

ABSTRACT: *This research work was conducted to evaluate the existing Environment Management System (EMS) of Attock oil Refinery Limited Rawalpindi, it is an ISO 14001:2004 certified company. A detailed study was made including challenges associated with training and awareness components of an ISO based system were identified. A detailed visit to Attock Oil Refinery Limited (ARL) revealed that it is following the rules and regulations of ISO1400:2004 clauses at maximum potential level and controlled operational conditions with lapse in certain areas. Major findings of this study are certain parameters in wastewater; air and solid waste are within permissible limits of NEQS and are following the safety policy. PM10 (47 Mg/Nm3), SO_2 (108 Mg/Nm3), CO (78Mg/Nm3), NOx (104Mg/Nm3) are in NEQS permissible limit in air. COD (139ppm), BOD (53ppm), pH (7.8), and oil and grease (8ppm), phenol (0.05ppm), temperature (1^{O} C), values are also within the permissible limit in wastewater C-sump. Disposal of sludge and empty drums is a major problem faced by ARL's solid waste management. Precautions regarding health and safety are taken precisely. Earmuffs are used in extremely noisy places. Carriage contractors keep their head lights on in refinery premises. Scrubbers installed in laboratory are active. Continuous check and close monitoring is done to reduce the exceeding parameters in respect of wastewater and air compared to quality standards. To avoid accidents, ARL management strictly follows health and safety policy. Attock Refinery Limited management is upgrading their sludge treatment process by adopting advanced composting. Empty drums and laboratory samples frequently disposed of.*

Keywords: Attock Oil Refinery (ARL); Environment Management System (EMS);Biological oxygen demand (BOD); Chemical oxygen demand (COD); National Environmental Quality Standards (NEQS); United States environmental Protection Agency (USEPA); National Cleaner Production Center (NCPC).

1. INTRODUCTION:

An Environmental Management System (EMS) serves as a tool to improve environmental performance. It provides a systematic way of managing an organization's environmental affairs. EMS is the aspect of organization's overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment. It gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes. It also focuses on continual improvement of system [12]. EMS is an assessment tool which internationally accepted and developed to meet the requirements of all the individuals and stake holders of an organization. It takes into accounts the day to day activities with environmental perspectives and mainly focuses on gradual and continual improvement of the operational procedure that favours' the environment. EMS can't be developed as separate system of an organization rather it is designed in such a way so that it can be applied to the existing system of that organization [9]. International organization for standardization (ISO) is a network of the national standards institutes of 148 countries, on the basis of one member per country, with central secretariat in Geneva, Switzerland, that coordinates the system. ISO is a non-governmental organization: its members are not as is the case in the United Nations system delegations' of national governments. Nevertheless, ISO occupies a special position between the public and private sectors [3]. ISO system is worldwide recognized and it significantly improves the excellence and vocation of industries, it is now getting esteem among industries to get the certification of ISO 14001. It is a sort of assurance that the respective industry is environmental friendly and its working and operations have minimum or no harmful effect on environment and is safer and cleaner [4].Implementation of EMS in oil refinery is of utmost importance because of greater chances of environmental hazards due to powerful and enormous operations and procedures carried out for the refining of crude oil [1].

The research was conducted at Attock Refinery Limited (ARL). ARL is a member of the Attock Group of Companies, a fully integrated group covering all segments of oil and gas industry from exploration to production, and refining to marketing of a wide range of petroleum products in Pakistan. ARL is strategically located up-country in the north of Pakistan and caters to the petroleum products requirements in its region of location and beyond. Since its commissioning in 1922, ARL has passed through various stages of transformation and stood the test of time through war and peace. From batch distillation stills of 2,500 barrels per day (BPD), today it has grown into a modern state-of-the-art Refinery with a capacity of 40,000 BPD. ARL was incorporated as a Private Limited Company in November, 1978 to handle the business of the Attock Oil Company Limited (AOC) relating to refining of crude oil and supplying of refined petroleum products. It was subsequently converted into a Public Limited Company in June 1979 and is listed on the three Stock Exchanges of the country. The Company is also registered with the Central Depositary Company of Pakistan (CDC).ARL's configuration/processing allows it to process from the heaviest to the lightest (12-65 API) crudes to produce a complete range of petroleum products from LPG to Asphalt including specialty products such as Jet Fuels (JP-1, JP-4 and JP-8) Cutback Asphalts, Polymer Modified

Asphalt, Mineral Turpentine Oil, Solvent Oil and Jute Batching Oil. ARL is receiving and processing crude from Northern and Southern oil fields of Pakistan. 70% of the crude processed at ARL is received through pipeline and rest through road bowsers. ARL's current nameplate capacity stands at 43,000 bpd and it possesses the capability to process lightest to heaviest (10-65 API) crudes. ARL's current Expansion / Up-gradation Projects comprises of Pre f lash unit, Naphtha Isomerization unit, Diesel Hydro Desulphurization (DHDS) unit and expansion of existing Captive Power Plant. This would increase refinery capacity by 10,400 bpd, motor gasoline production would increase by 20,000 Tons per month and would enable ARL to produce Euro II compliant low sulphur diesel. These Projects are expected to be completed by September 2015. The Company is ISO 9001, ISO 14001, ISO/IEC 17025, OHSAS 18001 certified and is the first refinery in Pakistan to declare implementation of ISO 50001 (Energy Management System).

Figure1: **Study area of Attock Oil Refinery.**

2. MATERIALS AND METHODS:

In order to evaluate the existing environment management system (EMS); ISO 14001 in Attok Oil Refinery, we evaluate it clause wise, with the help of Questionnaire, published literature, interviews and industrial document. According to its clause; 4.1, 4.2, 4.3, 4.4, 4.6 (General Requirements, Environmental Policy, Planning, Implementation and operation, Management Review); ARL has well established Environment management manual. According to its clause 4.5 (Checking), we use NEQS and USEPA guidelines. For this different monitoring instrument used, collection of representative sample analysis is done and then the results were interrupted in tabular form. After that they were compared with recommended standards. During study work samples are taken three times randomly to check the effluent and emission from the refinery premises and effort were made for the implementation of Quality control Lab and assurance protocol during sampling.

2.1 Stack Gas Analysis:

For the analysis of the emission from the stacks, eight stacks are selected throughout the refinery, one from heavy crude unit (HCU), two from Distillation Unit (HBU-I) and one from Distillation Unit (HBU-II), three from boiler house, one from LUMMUS plant. Lancon Series II Portable Flue Gas Analyzer is used for the analysis of the emission from the stacks.All the connections are carefully. The apparatus is calibrated for 180 seconds. Then it is set to detect the required parameter CO, H_2S, NOx, and SO_2 for which the probe is kept in Stack for five minutes.

2.2 Ambient Air Analysis

For the analysis of ambient air these sites are selected; main gate, fire and safety, power plant, Heavy crude unit (HCU) and Crude decanting area. German manufactured DRAGER ambient air quality monitoring equipment was used for this purpose. Monitoring was carried out for Sulfur dioxide (SO_2), Nitrogen oxides (NO_x--NO and NO_2), and Carbon monoxide (CO).PITMAN MODEL.705 Lead Analyzer is used for the analysis of Lead in the air.Low volume sampler is used for the particulate matters in the air. The vacuum procedure is adjusted to 150mbar while flow is adjusted at 8Lit/mint. After connecting all the connections carefully the apparatus is

operated for 20minutes. A pre-weighted filter paper is used which is dried initially at a temperature of $103C^0$ in oven for 30 minutes. After completing the experiment the filter paper is kept in the desiccators, dried for 30 minutes in an oven and again weighed.

Particulate matter =Initial weight- final weight

2.3 Examination of waste water

The waste water system consist of an open drain system that collects effluent from process drains and surface runoff, separation facilities and an induced air flotation system. All hydrocarbon waste including desalted water and caustics are disposed of through this system but clean effluent – cooling tower blow down, boiler blow down, etc. are segregated until the point of final discharge as shown in fig 2.The samples are preserved for COD analysis for 2 days in glass bottles at preservation temperature $4C^o$ but for BOD_5, TSS & TDS samples are ready for immediate tests. Grab sampling collection method was used during the sampling. The following parameters are subjected to be analyzed generally;

2.3.1 Biological Oxygen Demand (BOD)

The BOD test is an empirical procedure which measure the dissolved oxygen consumed by microbial life while assimilating and oxidizing the organic matter present. The standard test conditions include dark incubation at 20 C^o for 5days. The standard EPA Method 405.1 is used for the calculation of BOD. The sample of waste is incubated for 5days at 20 C^o in the dark. The reduction in dissolved oxygen concentration during the incubation period yields a measure of the biochemical oxygen demand.

2.3.2 Chemical oxygen demand (COD)

The COD method determines the quantity of oxygen required to oxidize the organic matter in a waste sample, under specific conditions of oxidizing agent, temperature and time. For COD analysis in ppm, USEPA 410 method is used.

2.3.3 Total suspended solids (TSS)

For measuring the TSS in ppm, USEPA 160.2 method is used. This method is applicable for drinking, ground, surface and saline waters, domestic and industrial wastes. The range of the determination is from 10 to 20,000mg/l. The quantization limit is10 mg/l total suspended solids (TSS).A well-mixed sample aliquot is filtered through a tarred standard glass fiber filter. The residue remaining on the filter is dried to constant weight at 103-105C. It total dissolved solids (TDS) area also being determined, the filtrate from this method may be used for the TDS analysis.

2.3.4 Oil Grease and phenol

The amount of oil, grease and phenol in water is also calculated under the USEPA standards. Oil and grease are measured by USEPA 413.1 scheme.While phenol is calculated by USEPA 420.1 test. Both these analysis determine the individual quantity in ppm**.**

2.3.5 PH

For pH measurement of the samples the standard EPA 150.1 is used.

2.4 Solid waste management

Five drums are placed at different location of the refinery to put different types of solid waste separately in fig 3. All these drums are labeled about the types of waste with colored labels. The Oily rags, plastic/polymer are disposed to incinerator and glass to storage for recycling, dry leaves/organics to landfill, paper to storage for recycling, Exhausted batteries, PVC coated cables deposited to general stores for proper storage and ultimate disposal/expert for recycle.

2.5 Waste chemical Disposal from Quality control lab.

QCL waste are of three types; acidic, basic and oily.

All three types of waste mentioned are collected in plastic cans, which are properly marked and tagged. All the cans are placed at safe areas. After performing the tests, laboratory analysis oil waste throws into the pit from where it is pumped to the storage tank and recycled at the plant. Acidic and basic wastes are collected into the vessels and neutralized before throwing into the main stream of effluent.

2.6 Sludge Removal

After the removal, sludge is collected manually in handcarts and stored into a pit, fuel for incinerator and bricks/caking of sludge and for road construction.

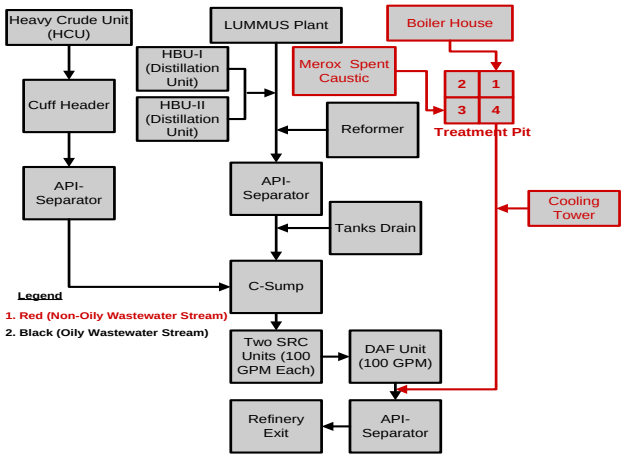

Figure2: Process Flow Diagram Of Proposed Project

Figure3: Solid Waste Management Scheme

3 RESULTS AND DISCUSSION

In an attempt to assess the deterioration in air quality at ARL and its surrounding areas. ARL through NCPC-Fuels undertook a project to monitor ambient air quality of ARL and its surrounding areas. The air quality monitoring that was conducted provides a basic understanding of issues associated with standard field sampling, measurement and laboratory test methods and procedures. Based on the analysis carried out in this research, NCPC-Fuels identified some observations, which are presented in this section. The checklist of ISO 14001 Environmental Management System were also filled after two way communication with the ARL personals, contractors of the ARL and health and safety workers of the ARL.A general view of the laboratory

facilities available in ARL for testing the air and water parameters is given in Table.

3.1. Stack Analysis

Results of eight stacks, one from HCU, two from HBU-I and one from HBU-II, three from the boiler house, one from LUMMUS and two from reformer unit are given in the table 3.1, 3.2, 3.3 (appendix) and parameters like CO, NOx, SO2 and PM are monitored. All parameters are within the permissible limits of National Environmental Quality Standards (NEQS) for the stack emissions. All the results were found within the permissible limits of National Environmental Quality Standards (NEQS) with a very wide gap between the results and the NEQS. Presently, QCL, ARL is performing stack analysis ona monthly basis.

3.2 Ambient Air Analysis

Results of seven sampling sites inside the refinery (i.e., main gate, fire & safety, power plant, HCU, area and crude decanting) are given in table 3.4(appendix) parameters like CO, NOx, SO2, H2S, PM10 and Pb were monitored. National Ambient Air Quality Standards in Pakistan are not available; therefore the results were being compared with USEPA guidelines for Ambient Air.

3.3 Outside Refinery (Surrounding Premises)

3.3.1 Pre-existing data

Pre-existing data concerning the air quality outside the refinery was taken into account due to lack resource. The documentation about the air quality outside the refinery was already present in ARL's record and is authentic and verified by the ARL management. Results of seven sampling sites outside the refinery, i.e. post office, Kotha Kalan, Ayub Park, New Lalazar, Caltex Depot, C-Line and Nai abadi are given in Table 3.8(appendix).

4 CONCLUSION AND RECOMMENDATION:

ISO 14001 is a strong beginning to global environment management system. Attock Refinery Limited management not only believes in providing the best quality productions to their customers but also goes an extra mile to ensure that all its processes are environmental friendly and to keep their discharges and emissions within the permissible limits of national environment quality standards. The refinery is following the rules and regulations of ISO 14001 clauses at maximum potential level but still there are certain areas which require improvement as pointed out during the study. Different recommendations were made for the improvement of the system keeping in view the refinery strategy and policy. Overall, the system is satisfactory and meets with the compliance requirement of ISO 14001 standards. The environmental policy, prepared by the top management is revised on annual basis and is implemented successfully throughout the refinery premises. All the NEQS parameters are approximately within permissible limits with the exception of the periodic excursion of pH, COD and oil and grease and to keep them under control ARL is working on different projects. The main focus of the ARL's management is to minimize the production of waste and to develop the concept of recycling. For this ARL have started different projects, like recycling of refinery waste water and its reuse in different process like feed water in various phases. The techniques identified in this report have general application to other refineries but the identification of source of emissions and the development of cleaner production strategies requires broad refinery knowledge. The recommendation of the study are following;

1. The largest source of emissions in the process area is the sewer system. Current design practice is to install a closed drain system for waste stream that are expected to contain significant concentrations of effluents.
2. It was also observed during our visits that technicians are not following the safety measures and some safety installations which are present there are not in working conditions. So with present awareness, more attention is given to the proper handling and disposal of different equipment and materials. All the staff is required to be properly trained and awakened to safely measures and for cleanup of spilled hazardous chemicals.

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Appendix

Table 3.1

Results of Stacks at ARL

Stack Caption	Types of Fuel	CO, Mg/Nm3	SO2, Mg/Nm3	NOx, Mg/Nm3	PM, Mg/Nm3
Boiler Stack-1	LP+HP+NG	98	84	95	52
Boiler Stack-2	LP+HP+NG	106	79	104	49
Boiler Stack-3	LP+HP+NG	94	76	99	50
HBU-I Stack-1 NO:3	OIL+GAS	99	93	105	53
HBU-I Stack-2 NO:28	OIL+GAS	101	104	97	54
HBU-II Stack-1 NO:3	OIL+GAS	103	100	104	51
HCU Stack-1 (H001)	OLI+GAS	110	103	99	47
LUMMUS Plant Stack	OIL+GAS	99	97	96	52
Reformer Stack-1 (SR-H-002)	Field Gas	83	95	98	47
Reformer Stack-2 (HT-H-002)	Field Gas	78	108	104	47
National Environmental Quality Standard (NEQS)		800	1700	400 (gas) 600 (oil)	300
Reciprocating type Engine Stack-1 for Power Generation	Furnace Fuel Oil	217	334	1130	153
Reciprocating type Engine Stack-2 for Power Generation	Furnace Fuel Oil	221	309	1065	150
National Environmental Quality Standard (NEQS)		800	1700		300
		compliance	compliance	compliance	compliance

Note: No limit for reciprocating type thermal power plant engines in NEQS. However, World Bank guidelines for such engines is max 2,000 mg/Nm3 for NOx.

Table 3.2

Results of Stacks at ARL

Stack Caption	Types of Fuel	CO, Mg/Nm3	SO2, Mg/Nm3	NOx, Mg/Nm3	PM, Mg/Nm3
Boiler Stack-1	LP+HP+NG	92	81	91	46
Boiler Stack-2	LP+HP+NG	105	76	105	50
Boiler Stack-3	LP+HP+NG	89	71	97	49
HBU-I Stack-1 NO:3	OIL+GAS	93	92	98	51
HBU-I Stack-2 NO:28	OIL+GAS	90	107	99	52
HBU-II Stack-1 NO:3	OIL+GAS	101	97	108	50
HCU Stack-1 (H001)	OLI+GAS	101	97	97	49
LUMMUS Plant Stack	OIL+GAS	103	94	96	53
Reformer Stack-1 (SR-H-002)	Field Gas	79	97	94	45
Reformer Stack-2 (HT-H-002)	Field Gas	76	102	102	46
National Environmental Quality Standard (NEQS)		800	1700	400(gas) 600 (oil)	300
Reciprocating type Engine Stack-1 for Power Generation	Furnace Fuel Oil	210	332	1131	151
Reciprocating type Engine Stack-2 for Power Generation	Furnace Fuel Oil	219	311	1067	149

National Environmental Quality Standard (NEQS)		800	1700		300
		compliance	compliance	compliance	compliance

Note: No limit for reciprocating type thermal power plant engines in NEQS. However, World Bank guidelines for such engines is max 2,000 mg/Nm3 for NOx.

Table 3.3
Results of Stacks at ARL

Stack Caption	Types of Fuel	CO, Mg/Nm3	SO2, Mg/Nm3	NOx, Mg/Nm3	PM, Mg/Nm3
Boiler Stack-1	LP+HP+NG	93	84	92	47
Boiler Stack-2	LP+HP+NG	106	78	103	48
Boiler Stack-3	LP+HP+NG	90	72	96	52
HBU-I Stack-1 NO:3	OIL+GAS	91	94	101	53
HBU-I Stack-2 NO:28	OIL+GAS	92	105	97	56
HBU-II Stack-1 NO:3	OIL+GAS	102	91	106	51
HCU Stack-1 (H001)	OLI+GAS	100	95	98	52
LUMMUS Plant Stack	OIL+GAS	103	96	99	54
Reformer Stack-1 (SR-H-002)	Field Gas	77	98	96	47
Reformer Stack-2 (HT-H-002)	Field Gas	81	103	104	47
National Environmental Quality Standard (NEQS)		800	1700	400 (gas) 600 (oil)	300
Reciprocating type Engine Stack-1 for Power Generation	Furnace Fuel Oil	212	333	1132	152
Reciprocating type Engine Stack-2 for Power Generation	Furnace Fuel Oil	221	313	1065	147
National Environmental Quality Standard (NEQS)		800	1700		300
		compliance	compliance	compliance	compliance

Note: No limit for reciprocating type thermal power plant engines in NEQS. However, World Bank guidelines for such engines is max 2,000 mg/Nm3 for NOx.

Table 3.4
Results of sampling sites inside ARL

Stacks	CO ppm	NOx ppb	SO2 ppb	H2S ppm	PM10 ug/m3	Pb ug/m3
Main gate	2	0	0	0	1875	0
Fire & Safety	1	0	0	0	625	0
Power Plant	3	0	0	0	1250	0
P & D	5	0	0	0	625	0
HCU	2	0	0	0	1250	0
TEL area	3	0	0	0	1250	0
Crude Decan,	5	0	0	0	3750	0
USEPA	35	-	130	-	150	1.5
	compliance		compliance		compliance	compliance

- United States Environmental Protection Agency(USEPA)

Table 3.5
Effluent Sample results

Sr#.	Test	Sampling Container	Preservation Time	Readings	NEQS
1	PH	Glass/Plastic	As early as possible	7.8	6-9
2	COD, ppm	Glass Bottles	2 Days	139	150
3	BOD5, ppm	Glass Bottles	5 Days	53	80
4	TSS, ppm	Glass/Plastic	For few hours	44	200
5	Oil & Grease, ppm	Glass Bottles	For few hours	8	10
6	Phenol, ppm	Glass/Plastic	2 Days	0.05	0.1
7	Temp. C*			1	40
8	Flow (GPM)			98	

- National Environmental Quality Standard

Table 3.6
Effluent Sample results

Sr #.	Test	Sampling Container	Preservation Time	Readings	NEQS
1	**PH**	**Glass/Plastic**	**As early as possible**	**7.69**	**6-9**
2	**COD, ppm**	**Glass Bottles**	**2 Days**	**142**	**150**
3	**BOD5, ppm**	**Glass Bottles**	**5 Days**	**58**	**80**
4	**TSS, ppm**	**Glass/Plastic**	**For few hours**	**48**	**200**
5	**Oil & Grease, ppm**	**Glass Bottles**	**For few hours**	**07**	**10**
6	**Phenol, ppm**	**Glass/Plastic**	**2 Days**	**0.06**	**0.1**
7	**Temp. C***			**1**	**40**
8	**Flow (GPM)**			**99**	

- National Environmental Quality Standard

Table 3.7
Effluent Sample results

Sr #.	Test	Sampling Container	Preservation Time	Readings	NEQS
1	PH	Glass/Plastic	As early as possible	8.28	6-9
2	COD, ppm	Glass Bottles	2 Days	145	150
3	BOD5, ppm	Glass Bottles	5 Days	50	80
4	TSS, ppm	Glass/Plastic	For few hours	58	200
5	Oil & Grease, ppm	Glass Bottles	For few hours	8	10
6	Phenol, ppm	Glass/Plastic	2 Days	0.04	0.1
7	Temp. C*			1	40
8	Flow (GPM)			98	

- National Environmental Quality Standard

Table 3.8
Results of sampling sites outside ARL

Stacks	Ozone ppb	CO ppm	NOx ppb	SO2 ppb	H2S ppm	PM10 ug/m3	Pb ug/m3
Post Office	0	2	0	0	0	1875	0
Kotha Kalan	0	4	0	0	0	625	0
Ayub Park	0	0	0	0	0	1250	0
New Lalazar	0	0	0	0	0	625	0
Calters Depot	0	3	0	0	0	1250	0
C-Line	0	3	0	0	0	1250	0
Nai Abadi	0	2	0	0	0	3750	0
Minimum	0	0	0	0	0	150	0
Maximum	0	5	0	0	0		0
Average		2.3	0	0	0		
WHO		3.5	110	124			
USEPA		3.5		140			

- United States Environmental Protection Agency
- World Health Organization