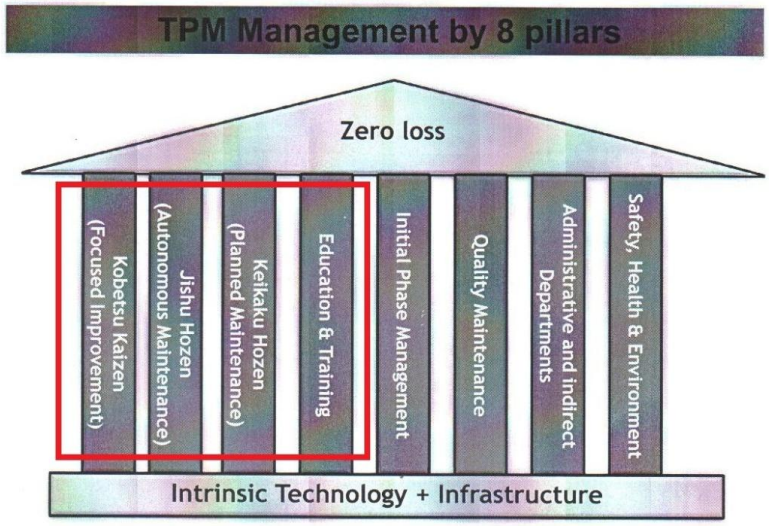
Implementing visual control in Mehr Petrochemical Company (MHPC)

a) Introduction

1) This paper is about implementing visual control in MHPC when I was working there as maintenance planning and Inspection Head. MHPC is located in north of Iran, Assaluyeh district, Pars Special Economic Energy Zone. MHPC is a High density polyethylene (HDPE) producer. It has the Yearly production of 350,000 tons HDPE. I worked in MHPC from August.22.2008 to April.5.2013.
2) This project comprise several separate small projects, it totally took 16 months from Oct.20.2011 to Jan.20.2013.

b) Background

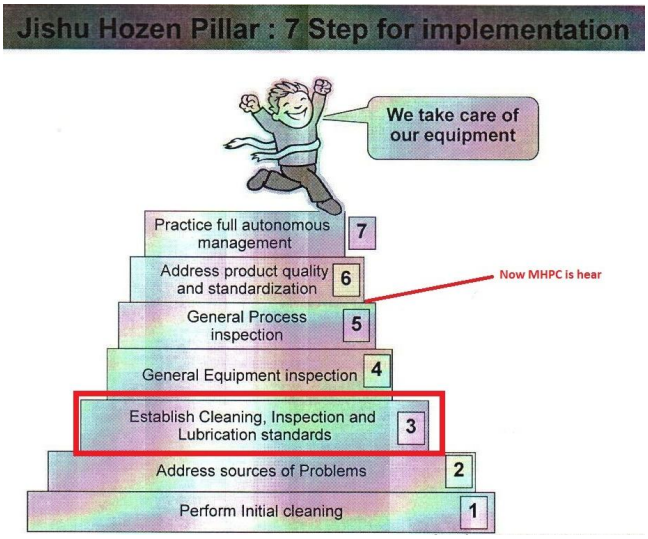
3) The general nature of this project was about implementing visual control which include a set of communication devices used in the work environment that tells us at a glance how work should be done and whether it is deviating from the standard. By applying visual control techniques it is possible to improve business performance by reacting to abnormalities in real time, Improve productivity by eliminating waste from critical processes, get everyone in organization aligned and involved with what is important to our customers and business, train people on standard processes that are actually used.
4) Part of MHPC share is owned by SCG a huge Thai holding. In Jul.2011 MHPC organized a 10 days training course about Total Productive Maintenance (TPM) for a group of employee, in Thailand in Thai Polymer Enterprise. During this course I visited HDPE Plant of SCG in Rayong.i saw many good practices in TPM implementation there. This visit and training gave us incentive to implement TPM in MHPC.
5) TPM was developed in the 1970's as a method of involving machine operators in the preventive maintenance of their machines - a reaction to increasing specialization and centralization of the maintenance function that had created division-of-labor barriers between operators and the maintenance of their machines and equipment. TPM has 8 Pillars, in MHPC at first we focused in first 4 pillars.



- ✓ First pillar is focused on improvement (Kobetsu Kaizen): in this pillar we focused on continuous improvement by using bottom up activities like 5S, one point Lesson (OPL), Suggestion system.
- ✓ Second pillar is autonomous maintenance, Jishu Hosen, (JH): in this pillar we changed the mindset that "I operate maintenance will fix it to, I operate I will fix it" we trained operators to do the routine maintenance job like lubrication, inspection, tightening and at the same time trained maintenance team more about process and encourage them to focus on innovation and improvement of equipment.
- ✓ Third pillar is planned maintenance (Keikaku Hozen): in this pillar we focused more on PM, review or PM programs to be more comprehensive and effective.
- ✓ Forth pillar education and training, It is aimed to have multi-skilled revitalized employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently.

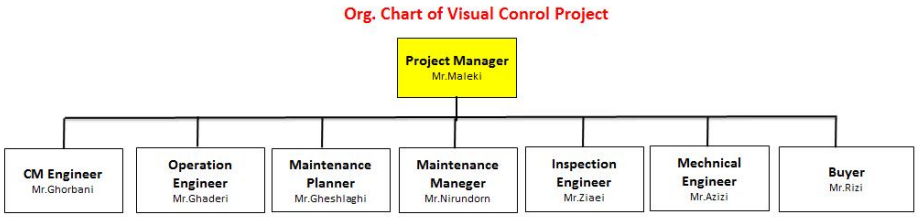
6) **In order to implement Second pillar, JH we gone through following stages**

- Stage 1 to clean equipment regularly, we arranged a big cleaning day and a regular planned cleaning in place.
- Stage 2 is to perform initial cleaning, we Improved contamination source and developed inaccessible places (easy to inspect, easy to clean, centralized lubrication)



- Stage 3 is establishing tentative standard, check sheet and visual control. I selected as project manager to implement this stage.

7) In first step as visual control Project Manager, I formed a team consisting of maintenance, operation and procurement staff, the following organization chart indicates my position in this project.



8) Objective of this project was to implement visual control in MHPC this include choosing the right techniques of visual control that fit MHPC requirement and deploying it properly in MHPC. The nature of my work as visual control implementation project manager was to coordinate team members, develop a schedule for stages of project, and determine target milestones, dates and responsibilities, control commitment and budgets.

c) Personal workplace activity

Selecting right technique of visual control for implementation

9) For choosing the proper technique of visual control for implementation, implementation team had several meetings and found issues that could be addressed by visual control in MHPC as

- ✓ Quality of lubrication of rotary equipment
- ✓ Enhancing control of parameters like temperature pressure and level at site with local gauges

- ✓ Improving vibration and temperature condition monitoring of rotary equipment at site
- ✓ Real time monitoring of rotating parts of equipment like chains and belts at site
- ✓ Fast and easy access to maintenance parameters of rotary equipment at site
- ✓ Giving information to shop floor employee about key performance indicators, vision, mission of business

In order to address mentioned issues, visual control project done through several small projects including lubrication visuals, inspection visuals, preventive maintenance visuals and information boards.

Lubrication Visuals

10) Lubrication errors (both under and over lubrication) are one of the major causes of equipment failures. To maximize OEE, ensure employees can easily find lubrication point, readily detect the proper levels, and correctly apply the right amount of lubricant at the appropriate time we adapted two effective approaches
    1- Installing display boards on each rotary equipment
    2- installing greasing information board on exact greasing point

11) For installing display boards on each rotary equipment, after several meetings implementation team finalized items that should be included in this board. Board content should be concise, informative and beneficial for technician or operator who wants to do the lubrication of equipment and CM technician which check the condition of equipment with a laser gun thermometer or a vibrometer. These boards provide handy information for technician who is doing alignment between an electromotor and rotary equipment during a maintenance job as well.

12) Display board content was

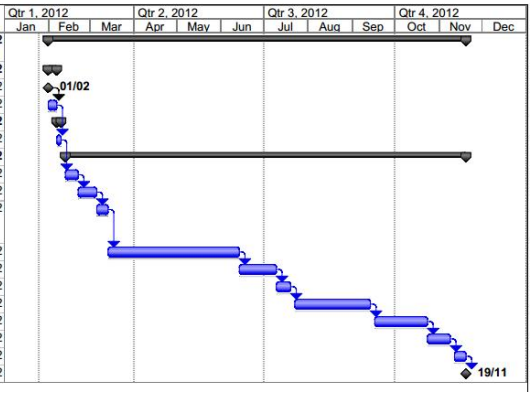
- ✓ Equipment number and description of equipment
- ✓ Schematic of equipment
- ✓ operation parameters like fluid, type, design Temp, design pressure(barG), revolution (rpm), type of driver, rated kW-Pole and drive and current(Amp)
- ✓ Condition monitoring parameters acceptance level like temperature and vibration
- ✓ Lubrication information like lubricant type, Part that should be lubricated, points of lubrication, quantity and interval of lubrication.
- ✓ Alignment specifications like Distance Between Shaft Ends (couplings technology) (DBSC)

13) Providing these data require cooperation of all team members. In this stage I provided the list of rotary equipment that is possible to install display board on from equipment list subsequently I determined the scope of work and provided a schedule for this project. Condition monitoring engineer provided information for acceptable vibration and temperature in different point in rotary equipment from CM history data of equipment. I extracted lubrication information from lubricant list document of site; I have drawn a schematic of each type of rotary equipment including pump, compressor, agitator, rotary valve, centrifuge and dryer to be a visual guide for lubrication and condition monitoring. I found technical specification of equipment like fluid, type, design

Temp, design pressure, revolution, type of driver, rated kW-Pole and drive and current(Amp) in equipment technical spec document.

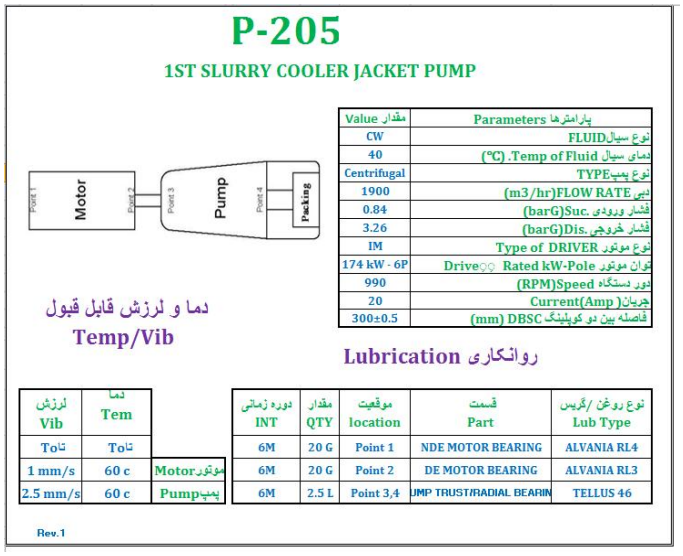
14) I devised a plan for installing these display boards as follows.

ID	Task Name	Duration	Start	Finish
1	**Installing Information board on Equipment**	**167 days?**	**Wed 01/02/12**	**Mon 19/11/12**
2	**Design**	**3 days?**	**Wed 01/02/12**	**Mon 06/02/12**
3	Start	0 days	Wed 01/02/12	Wed 01/02/12
4	Design the shape and material	3 days?	Wed 01/02/12	Mon 06/02/12
5	**Purchasing**	**3 days?**	**Tue 07/02/12**	**Thu 09/02/12**
6	Purchasing Material	3 days?	Tue 07/02/12	Thu 09/02/12
7	**Implementation**	**161 days**	**Mon 13/02/12**	**Mon 19/11/12**
8	Making a prototype	6 days	Mon 13/02/12	Tue 21/02/12
9	Organizing data content	7 days	Wed 22/02/12	Mon 05/03/12
10	Installing the prototype and finalizing the design	5 days	Tue 06/03/12	Tue 13/03/12
11	Section 100, 106 pcs	53 days	Wed 14/03/12	Wed 13/06/12
12	Section 200 , 28 pcs	14 days	Thu 14/06/12	Mon 09/07/12
13	Section 300 ,14 pcs	7 days	Tue 10/07/12	Thu 19/07/12
14	Section 400 , 65 pcs	32 days	Mon 23/07/12	Thu 13/09/12
15	Section 700 ,44 pcs	22 days	Mon 17/09/12	Tue 23/10/12
16	Section 800 , 21 pcs	10 days	Wed 24/10/12	Thu 08/11/12
17	Section 900 , 7 pcs	5 days	Mon 12/11/12	Mon 19/11/12
18	End	0 days	Mon 19/11/12	Mon 19/11/12



15) In order to make the display board light, easy to install and access I decided to use aluminum material for board and install it on Local Control Switch of each rotary equipment with nut and bolt in this way I eliminated the need for installation of separate stand for theses boards at site and effectively reduced the project cost. Using bolt and nut instead of welding for installation boards helped to reduce the risk of installation work at site from a welding hot job to a low risk drilling job. in addition I did not use any glass since these board have installed at site next to equipment using glass would have increased the probability of breaking the glass and injury to operators or maintenance crews. Instead I laminated the board contents paper with a 3 mil transparent film to secure it against rain and sun. Procurement guy of team Mr.Rizi after receiving required material managed to find a local source that could supply these boards. After making the first sample as prototype, I managed to install 285 display boards on equipment during 10 months.

16) A sample of installed board is as follows.



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1ST SLURRY COOLER JACKET PUMP

Parameters پارامترها	Value مقدار
FLUIDنوع سیال	CW
(℃) .Temp of Fluid دمای سیال	40
TYPEنوع پمپ	Centrifugal
(m3/hr)FLOW RATE دبی	1900
(barG)Suc. فشار ورودی	0.84
(barG)Dis. فشار خروجی	3.26
Type of DRIVER نوع موتور	IM
Drive○○ Rated kW-Pole توان موتور	174 kW - 6P
(RPM)Speed دور دستگاه	990
Current(Amp)جریان	20
(mm) DBSC فاصله بین دو کوپلینگ	300±0.5

دما و لرزش قابل قبول

Temp/Vib

Lubrication روانکاری

لرزش Vib	دما Tem		دوره زمانی INT	مقدار QTY	موقعیت location	قسمت Part	نوع روغن /گریس Lub Type
Toتا	Toتا		6M	20 G	Point 1	NDE MOTOR BEARING	ALVANIA RL4
1 mm/s	60 c	Motorموتور	6M	20 G	Point 2	DE MOTOR BEARING	ALVANIA RL3
2.5 mm/s	60 c	Pumpپمپ	6M	2.5 L	Point 3,4	UMP TRUST/RADIAL BEARIN	TELLUS 46

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17) For second approach, installing greasing information board on exact greasing point, I printed the important information for greasing of each rotary equipment on an aluminum plate and attached it to the nearest possible position of related grease nipple. I chose aluminum plate because it is light, easy to spot and above all is highly resistance to humid weather of Assaluye. This information includes exact part for applying grease, type of lubricant, volume and interval of lubrication.
18) By installing these boards we considerably reduced the human errors in lubrication jobs and reduced the rotary equipment failure rate. During this project I installed 232 pieces of these boards on equipment.

A sample is shown in bellow picture.

Inspection Visuals

19) Inspection visuals like labeling the accepted range on local instruments like gauges at site make it easy for operators or anyone in the plant to quickly detect operating abnormalities and emerging failures before them happen.in order to install Indicators on local gauges in first stage I provided the list of local gauges, level meters and oilers at sit from instrument and mechanical equipment list to estimate the scope of work. There was 712 pieces of instruments for this project. Then I asked operation engineer of team to provide upper, lower and normal range of each instrument. It took 2 month and

finally I have received intended information. I provide a schedule for completing the project of installing indicator on local gauge as follows.

SCHEDULE FOR MARKING GAUGE					2011			2012												2013
INSTRUMENT TYPE	AREA	QTY	Estimated TIME FOR PREPARATION RANGES(HOUR) BY OPERATION	Estimated TIME FOR INSTALATION (HOUR) BY MAINTENANCE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
PRESSURE GAUGE	MAIN	89	89	44.5																
	PELLETIZING	78	78	39																
	BAGGING	1	1	0.5																
	DISTILLATION	95	95	47.5																
	UTILITIES	235	235	117.5																
DIFF. PRESS. GAUGE	MAIN	1	1	0.5																
	PELLETIZING	15	15	7.5																
	UTILITIES	5	5	2.5																
LEVEL GAUGE	MAIN	16	16	8																
	PELLETIZING	16	16	8																
	DISTILLATION	14	14	7																
	UTILITIES	18	18	9																
TEMP. GAUGE	MAIN	26	26	13																
	PELLETIZING	33	33	16.5																
	DISTILLATION	18	18	9																
	UTILITIES	52	52	26																
	TOTAL	712	712	356																

20) All the gauges has been labeled with three colors of green for set value, yellow for accepted range and red for unacceptable range. For mechanical seal oil levels and oilers the same job was done to ease the control of condition of equipment.

21) Bellow picture shows a sample of gauge and seal pot oil level.

Predictive Maintenance visuals

22) in order to use visuals to ensure that vibration and infrared temperature measurements are taken at the exact same spot each time, no matter who takes the reading; to ensure comparable data over time I suggested to highlight the exact measuring point on each equipment through painting the measuring points.

23) As per operation feedback these indicators noticeable eased the controlling of operation parameters at a glance without need to refer to operation set points document. Furthermore it helped maintenance people to check condition of equipment during walk downs at site with least effort.

Keeping shop floor people informed

24) Employees need visual displays that show what is expected of them and how they are performing against those goals. These information boards are critical to success of TPM

because they show trends in key performance indicators. I mange to provide maintenance activities information boards for better communicate of maintenance key performance indicators. I updated monthly performance report of maintenance in these boards. A sample of installed board is shown bellow.

Training and engagement employees in visual control

25) To engage all employees in making a visual factory, visual control team decided to train employee about visual control concept and form a visual control suggestion committee to make visual control a permanent ongoing practice in MHPC. This policy gave incentive to all employees to find activities that could be enhanced through visual control. I held 3 training session for employee and teach the basics, philosophy, benefits and samples of visual control. As a result of employee participation in visual control suggestion we found many innovative ideas. MHPC mangers set some presents for applicable and innovative suggestions. Bellow picture shows the implementation of one of suggestions. In order to make it possible to inspect the chain of control valve in run time, an inspection window cut out of chain cover and secured by a thick transparent plastic film.

d) Summary

26) Implementation of the visual control as a pillar of planned maintenance of TPM was completed in Jan.2013. As a result of this project visual control concept established in MHPC and MHPC turned to a visual factory. Visual controls helped employees avoid wasting time by giving them the information they need, where and when they need it; Furthermore, it significantly helped improve reliability of plant through improving quality of lubrication. it is noticeable that visual control is not a once a lifetime project, but it is a continuous improvement philosophy, once some sample has been done in MHPC and employee see the benefits, they will encourage to find ways in their job to improve by visual control concept.