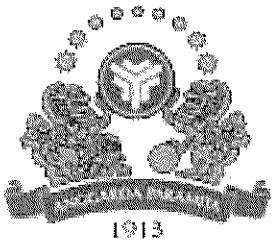
Energy Audit Final Report
September - 2014



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5.0 Energy conservation measures

5.1 Compressed air system

5.1.1 Arrest air leakages in compressed air distribution system

Background

Air leak test was carried out during the energy audit field measurement, when all machineries were kept as ideal during launch time & Friday lunch time with running of compressors in PP & CP area.

Findings

Compressor of above locations are run during the leakage test and noted the air flow and it is observed that air consumption is around 1776 m^3/hr out of this 50% is useful leakage.

Recommendation

Arrest air leakage points by plugging all air leakages and bring down to allowable leakage up to 10% as per industries limit. Arresting leakages will reduce the compressor loading time and thereby reducing the energy consumption of the compressor and also factory will able to stop some of compressor.

Benefits

The cost benefit analysis is given below:

Table 4. *Cost benefit analysis for arresting of compressed air leakage*

Description	Unit	Value
Total air leakage quantity	m^3/hr	1,776
Proposed leakage quantity to be arrest	%	50
	m^3/hr	888
Specific power consumption of present CENTAC compressors	kWh/m^3	0.175
Annual Operating hour	Hrs	8,160
Estimated total compressed air saving per hour	kWh	155.58
Estimated annual energy saving	kWh	1,269,569
Energy cost	Rp/kWh	1,057
	USD/kWh	0.091
Estimated annual monetary saving	USD	115,683

Description		SPP Office Chiller-2	PD Chiller-1
Power consumption	kW	74.8	75
Chiller TR loading percentage	%	41.7%	37.0%
Specific Power Consumption	kW/TR	1.80	1.62
Proposed system			
Water cooled screw chiller with VSD	TR	100	125
Specific Power Consumption	kW/TR	0.65	0.65
Reduction in specific energy consumption	kW/TR	1.15	0.97
Annual operating hours	Hr	3,400	8,760
Expected annual energy saving	kWh	162,237	394,265
Energy cost	Rp/kWh	1,057	1,057
	USD/kWh	0.0911	0.0911
Estimated annual monetary saving	USD	14,783	35,926
	Million Rp	171	416
Estimated Investment	USD	65,574	81,967
	Million Rp	760	950
Payback	Months	53	27

5.2.3 Optimize system pressure drop in identified AHU's

Background

Sampoerna, sukorejo plant has installed AHU's to cater the cooling air in SKM-1,3 &4 and ATB area . During the energy audit survey it was found that many of AHU's were operating at high system pressure and it's results more energy consumption in AHU fan.

Findings

Optimize system pressure drop on identified AHU's unit by cleaning filters & cooling coil unit to reduce its power consumption.

Recommendations

It is recommended to clean the filters and coil unit to reduce the head loss so that fan flow can be increased after clean the filters & coil units. After doing the above cleaning, which are results less system drop in AHU's system, So that AHU fan power consumption will be reduced.

Benefits

The Cost benefit analysis is as follows

Table 8. *Cost benefit analysis of system head loss optimization*

Description	Unit	ATB AHU-01	ATB AHU-03	ATB AHU-04	SKM1 AHU-0003	SKM1 AHU-0004	SKM1 AHU-0001	SKM1 AHU-0002	SPP-2 Carrier AHU-2
Present system									
Suction pressure before suction filter	mmWC	-15	-19	-17	-10	-10	-15	-11	-6
Suction pressure after suction filter	mmWC	-75	-78	-80	-30	-32	-36	-34	-25
Suction Pressure before fan (After cooling coil)	mmWC	-85	-96	-110	-51	-56	-50	-49	-40
Present head loss across filter	mmWC	-60	-59	-63	-20	-22	-21	-23	-19
Actual Power consumption by AHU fan motor	kW	14.3	13.9	13.7	10.4	9.7	10.6	10.5	16.3
Proposed system	**Clean suction filter frequently**								
Present head loss across filter		-60	-59	-63	-20	-22	-21	-23	-19
Power consumption	kW	3.78	4.76	5.11	6.17	5.64	5.94	5.28	6.2
Reduction in fan power consumption	kW	10.52	9.14	8.59	4.23	4.06	4.66	5.22	10.1
Annual operating hours per year	hr/yr	7,920	7,920	7,920	7,920	7920	7920	7920	7,920
Energy cost	Rp/ kWh	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057
Annual energy savings	kWh	83,331	72,376	68,031	33,519	32,175	36,877	41,313	79,988
Annual monetary savings	million Rp	88.1	76.5	71.9	35.4	34.0	39.0	43.7	84.5
	USD	7,593	6,595	6,199	3,054	2,931	3,360	3,764	7,288
Estimated investment	USD	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Total annual savings	USD	41,173							
Total estimated investment	USD	40,000							
Payback period	Months	12							

5.2.4 Provide a central exhaust system in SKM-4 filter maker machines.

Background:

In SKM-4 are seven filter makers are operating with an individual exhaust system and individual exhaust air is releasing hot air inside the department at 55 °C , which is putting additional heat load inside the SKM-4 department and it's results an additional power consumption on air conditioning unit.

Findings

Individual machine exhaust is putting into additional heat load inside the department and it's compensating by air condition unit to maintain the room temperature which is form of energy wastage.

Recommendations

Provide a centralised exhaust system for all filter maker units by providing with a common duct and a common blower for all seven machines. Once the all exhaust air will be taken out by a common duct then heat load inside the department will come down and air condition load will be less which is consumes less power.

Benefits:

The cost benefit analysis is given below:

Table 9. *Cost benefit analysis for centralized exhaust system*

Description	Unit	SKM-4 Filter maker
Present system		
Total filter maker machines are in operation	no's	7
Average temperature of exhaust air releasing inside department	oC	53
Total exhaust air from all 7 machines	M3/hr	5600
Total heat load generated by all exhaust	Kcal/hr	71232
Total AC load is compensating by all 7 filter maker exhaust	TR	24
Actual specific energy consumption by chiller	kW/TR	1.7
Additional power consumption by chiller due to additional heat load	kW	40.0
Proposed system	**Central exhaust system for all filter maker machines**	
Estimated power consumption by a common blower	kW	5
Reduction in cooling load in SKM-4	kW	35.04
Annual operating hours per year	hr/yr	8,400
Energy cost	IDR/kWh	1057
Annual energy savings	kWh	294,373
Annual monetary savings	million IDR/year	311
	USD/year	27,056
Estimated investment for a common blower & ducting etc	USD	20,000
Payback period	Months	9

5.2.5 *Replace all Package chillers with centralised chilled water system in filter maker machines.*

Background:

Nine filter makers in SKM area, two filter makers in SKM-1 area and seven filter maker machines are in SKM-4 area are cooled by chilled water which is supplied by two number individual package chillers in each machine.

Findings

Specific energy consumptions of these air cooled chillers are high as compared to the water cooled centralized chiller. The details temperature setting is given below:

Table 10. *Package chiller details*

Description	Set Temperature °C	Package chilled water Unit's
Filter Maker (SKM-1)-11	6	2.00
Filter Maker (SKM-1)-15	5	2.00
Filter Maker (SKM-4)-40	10	2.00
Filter Maker (SKM-4)-41	10	2.00
Filter Maker (SKM-4)-42	10	2.00
Filter Maker (SKM-4)-43	8	1.00
Filter Maker (SKM-4)-44	5	2.00
Filter Maker (SKM-4)-45	5	2.00
Filter Maker (SKM-4)-49	8	2.00

Recommendations

Replace all existing package chillers unit in filter makers by centralized chilled water system which is capable to reduce the overall energy consumption of package chillers with better cooling effects.

Benefits:

The cost benefit analysis is given below:

Table 11. *Cost benefit analysis to replace package chillers by centralized chilled water system*

Description	Units	Filter Maker
Approximate total TR generated by all mini chillers	TR	18.60
Average specific energy consumption by mini chillers	kW/TR	2.20
Average specific energy consumption by centralized chiller	kW/TR	0.65
Reduction in specific energy consumption	kW/TR	1.55
Expected power saving	kW	28.83
Annual operating hour	Hrs	8,160
Expected annual energy saving	kWh	235,253
Energy cost	IDR/kWh	1,057
	USD/kWh	0.0911
Estimated annual monetary saving	USD	21,436

Description	Units	Filter Maker
	Million IDR	248
Estimated investment	USD	15,000
	Million IDR	174
Payback	Months	8

5.3 Boiler, Hot air generator and Electric Heaters

5.3.1 *Avoid heat loss in feed water pipe of PP-1 boiler.*

Background

Feed water pipe is not insulated in PP-1 boiler and the surface temperature of pipe is around 96 ^{O}C which is very high and unsafe for safety .

Findings

Heat loss in bare pipe which is results additional gas consumption in boiler due heat loss.

Recommendation

Insulate all feed water line from dearator to boiler drum, so that heat energy can saved in terms of thermal energy and it's results less consumption in boiler

Benefits:

The cost benefit analysis is given below:

Table 12. *Cost benefit analysis for feed water pipe insulation in PP-1.*

Description	Unit	Value
Feed water Bare pipe surface area in PP-1	m^2	4.37
Ambient temperature	°C	34
Bare pipe surface temperature	°C	98
Insulation thickness	m	0.05
Insulated pipe surface temperature	°C	55
Insulated pipe surface area	m^2	5.31
CV of NG as per gas bill	m^3/MMBTU	29
	kCal/m^3	8,689.51
Present heat loss	kCal/hr	3,688.9
Heat loss after insulation	kCal/hr	1,232.2
Heat loss reduction	kCal/hr	2,457
Annual operating hour	Hr	8,160
Annual heat loss reduction	kCal	20,046,703

Description	Units	FTD
Proposed System	**Plate heat exchanger**	
Proposed feed water temperature	°C	80
Heat recovered by feed water	kCal/hr	319,792
Reduction in Natural gas consumption	M3/hr	32.5
Energy save per hour	MMBTU/hr	1.1
Annual operating hours	hrs/annum	5,280
Energy cost	USD/MMBTU	6.43
Cost of Natural gas	Rp/M3	750
Annual monetary savings	MRp	561.9
	USD	48,440.3
Estimated Investment	USD	150,000
Payback period	Months	37

5.5 Dust collectors

5.5.1 *Provide pressure feedback control in SKM-3 dust collector fan*

Background

SKM-3 dust collector is running with VSD without any pressure feedback and fan is operating at manual VSD control irrespective of machine operation and suction demand at machine end.

Findings

Pressure difference at user end and generation end is high based on machine operation and it's doesn't have any pressure controlled and fan is operating at manual mode which is energy waste.

Recommendation

Provide proper pressure feed back with logic control and VSD, so that energy can be saved and operation will be smoothed. So that existing VSD will operate at lesser speed based on suction pressure at machine end which is results lesser power consumption.

Benefits:

The cost benefit analysis is given below:

Table 18. *Cost benefit analysis for provide pressure feedback control in SKM-3 dust collector fan*

Description	Unit	SKM-3 Dust collector (D-32)
Present system		
Suction pressure near machines	mmWC	-1,180
Suction pressure before bag filter	mmWC	-1,250