ENERGY SAVING OPPORTUNITIES IN HOSPITALITY INDUSTRY

By

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The Hospitality Industry targets to provide the best comfort conditions to its guests.

Comfort conditions include Air-conditioning, Hot & Cold Water, Proper Toilet Exhaust, Good Lighting Level, fire Safe environment with a proper Smoke exhaust system etc.

In order to improve the energy efficiency one has to understand where the energy is being consumed.

As the saying goes;

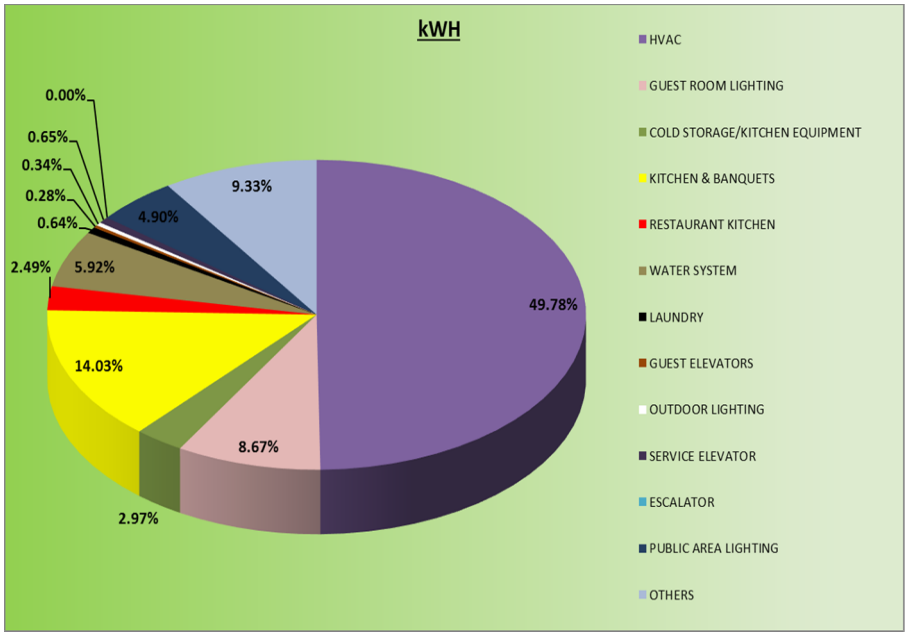
“ IF YOU WANT TO CONTROL IT, YOU MUST MEASURE IT “

Following Slide Shows, Energy Consumption of the Various Components with their respective percentages.

This is an actual break-up for the month of August 2019, obtained from Hotel The Taj Palace, New Delhi

The Taj Palace is a 5-Star Deluxe Hotel with 400 Rooms

The PIE Chart Showing Various Components:-



It can be seen that Air-conditioning consumes approximately 50% of the Energy and hence provides the biggest opportunity for the savings.

Listed below are the opportunities for improving the Energy Efficiency of the Air-conditioning system:-

Installing V.F.D on

- Chillers
- Chilled water pumps
- Cooling Tower Fans
- Air-Handling Units

These days most of the New Installations are opting for factory fitted VFD Chillers.

However, retro fitting VFD on existing chillers is a very viable option.

A Comparison between a VFD Chiller and Non-VFD Chiller of 650 TR Capacity (data provided by M/s Trane) is shown in following slide:

PART LOAD EFFICIENCIES OF A CENTRIFUGAL CHILLER AT AHRI RELIEF		
DESCRIPTION	VFD	STAR DELTA
Chiller Capacity	650 TR	650 TR
No. of Compressors	Single	Single
Type of Starter	VFD	Star Delta
IkW/TR @ 100% Load	0.6387	0.6348
IkW/TR @ 90% Load	0.5574	0.5839
IkW/TR @ 80% Load	0.49	0.5523
IkW/TR @ 70% Load	0.4241	0.5369
IkW/TR @ 60% Load	0.3644	0.5252
IkW/TR @ 50% Load	0.3124	0.523
IkW/TR @ 40% Load	0.3254	0.5582
IkW/TR @ 30% Load	0.3548	0.5968
IkW/TR @ 20% Load	0.4016	0.7153

SAVINGS

DESCRIPTION	VFD	STAR DELTA
Average IkW / TR	0.474	0.556
Annual TR - Hours	2,340,000	2,340,000
Annual kW-Hours	1,108,923	1,302,163
Electricity Tariff @ 9 INR / kW/Hr.	9	9
Annual Electricity Expense (INR - Lakhs)	99.8	117.2
ANNUAL SAVINGS IN (INR - Lakhs)	**17.40**	

Basis of above Calculations:
Chiller Operating Hours / Day - 16
Operating days / Year - 300
Average Chiller Load - 75%

Payback Analysis		
	VFD	STAR DELTA
Price of Chiller 650 TR (INR-Lakhs)	7,705,000	6,205,000
Quantity	1	1
ADDITIONAL COST OF VFD CHILLER (INR)	1,500,000	
Savings Due to VFD (INR - Lakhs)	1,740,000	
Payback, (No. of Years)	0.86	
SAY	**10 - 11 MONTHS**	

- Most Chilled Water Systems today are designed with VFD's on **Chilled Water Pumps** for operational reasons
- Installing VFD o**n Cooling Tower Fan** is also relatively easy, but the pay-out is not as attractive.

VFD ON AIR HANDLING UNITS

Our Analysis shows that installing VFD on **Air Handling Unit** only makes sense when motor capacity is 7.5 KW or more.

The Payback / ROI is between 1 ½ to 2 years.

Following Slide Shows Payback Analysis for Retro-fitting VFD In AHU's

Assumptions:

Duty Cycle Considered
100% System Flow (Full load) for 10% of the time
90% System Flow (Full load) for 20% of the time
80% System Flow (Full load) for 60% of the time
70% System Flow (Full load) for 10% of the time

Description	kW	kW
AHU MOTOR (Rated Capacity)	15	9.3
FULL LOAD AT 80 % Without VFD	12	7.4
TOTAL RUN TIME / DAY (Hrs)	18	18
TOTAL kWH / DAY Without VFD	216	133
TOTAL kWH / DAY With VFD (Considering Duty Cycle)	179	111
Energy Units Saved / Day	37	22
Energy Units Saved / Annum	13505	8030
Electricity Charge (Rs / Unit)	9	9
Cost Saved (Rs)	121,545	72,270
Cost of VFD with Retro-Fitting Charges (Rs)	125,000	110,000
PAYBACK IN YEARS	**1.0**	**1.52**

Retro-Fitted VFD on Air Handling Unit

Retro-Fitted VFD on Air Handling Unit

Factory Fitted VFD on Air Handling Unit

Factory Fitted VFD on Air Handling Unit

Automatic Tube Cleaning System

For Condenser Tubes of a Chillers.

This ensures that heat transfer surface shall remain clean at all times and chillers run at the designed efficiency.

Reduces Maintenance Cost Including Consumables

Comparison between Clean and Foul Conditioned Condenser Coils.

Description	UNDER FOULED CONDITIONS	CLEAN CONDITIONS (ATCS)
Chiller Capacity	650 TR	650 TR
No. of Compressors	Single	Single
Type of Starter	VFD	VFD
Part Load Data at AHRI Relief		
IkW/TR @ 100% Load	0.6387	0.6131
IkW/TR @ 90% Load	0.5574	0.5343
IkW/TR @ 80% Load	0.49	0.47
IkW/TR @ 70% Load	0.4241	0.402
IkW/TR @ 60% Load	0.3644	0.3478
IkW/TR @ 50% Load	0.3124	0.2992
IkW/TR @ 40% Load	0.3254	0.3135
IkW/TR @ 30% Load	0.3548	0.3456
IkW/TR @ 20% Load	0.4016	0.3978

Payback Analysis

	UNDER FOULED CONDITIONS	CLEAN CONDITIONS (ATCS)
Average ikW/TR of system	0.474	0.453
Annual TR - Hours	2,340,000	2,340,000
Annual kW-Hours	1108923	1058883
Electricity Tariff @ 9 INR / kW/Hr.	9	9
Annual Electricity Expense (INR - Lakhs)	99.80	95.30
SAVINGS (INR-LAKHS)	4.50	

Basis of above Calculations:

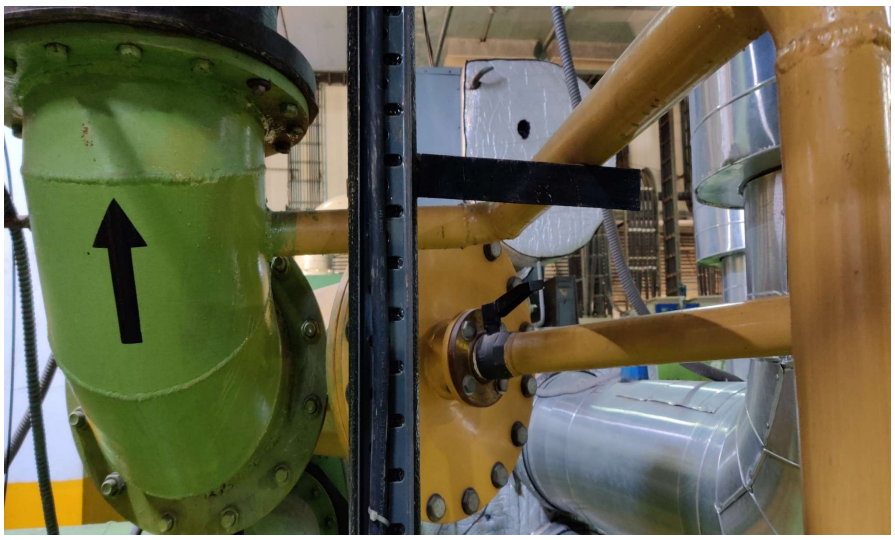
Chiller Operating Hours / Day - 16
Operating days / Year - 300
Average Chiller Load - 75%

Payback Analysis	
Price of ATCS (INR)	750,000
Quantity	1
Saving Per Year	450,000
Payback, (No. of Years)	**1.67**

The old way to clean your heat exchanger

ATCS Fitted to Chiller

ATCS Fitted to Chiller



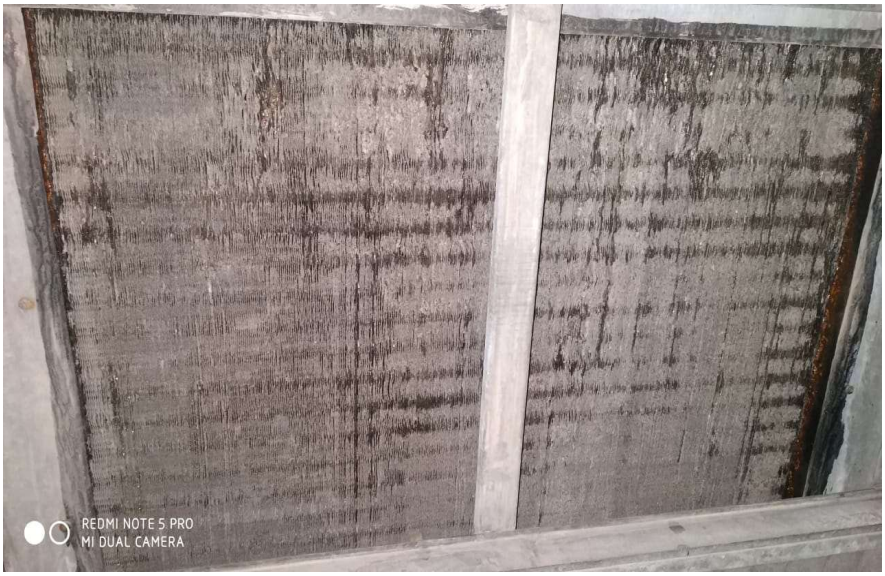
ATCS Fitted to Chiller

Use of **U.V Tubes** in Air Handling Units:

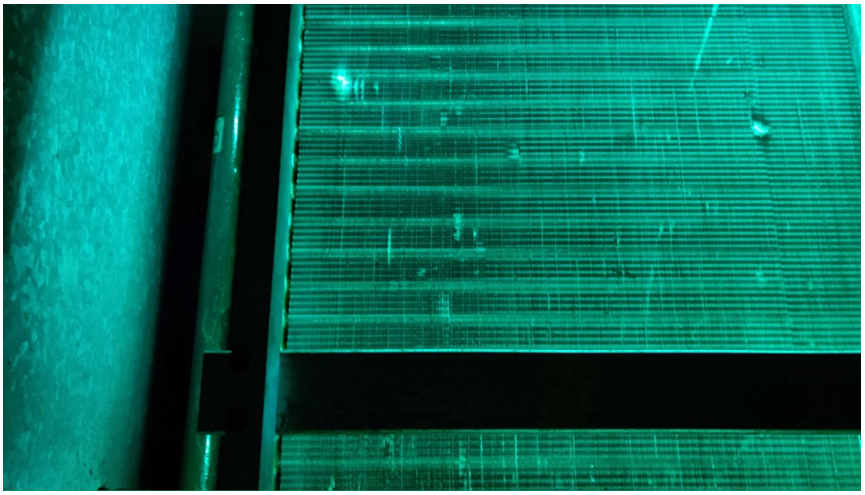
- Disinfect the Surface of the Coil
- De-activate Sticky Bacteria to Grow, which in turn, doesn't allows Dust to stick on coils
- Improves Heat Transfer
- Coil Maintenance with Consumables Reduces Substantially
- By Default – Air Quality Improves

Air Handling Unit without U.V Tubes

Air Handling Unit without U.V Tubes



Actual Photograph showing UV Tube Installed on Cooling Coils



COILS CONDITION WITH USING UV TUBES

Energy Saving
in
Laundry & Kitchen
Using
‘Spot Cooling System’

- The Principal of Spot Cooling is to remove (exhaust) the heat at the point of generation and not to allow it to spread in the nearby areas.

- Thus the Air-Condition load is of the area WITHOUT the heat load of the Equipment.

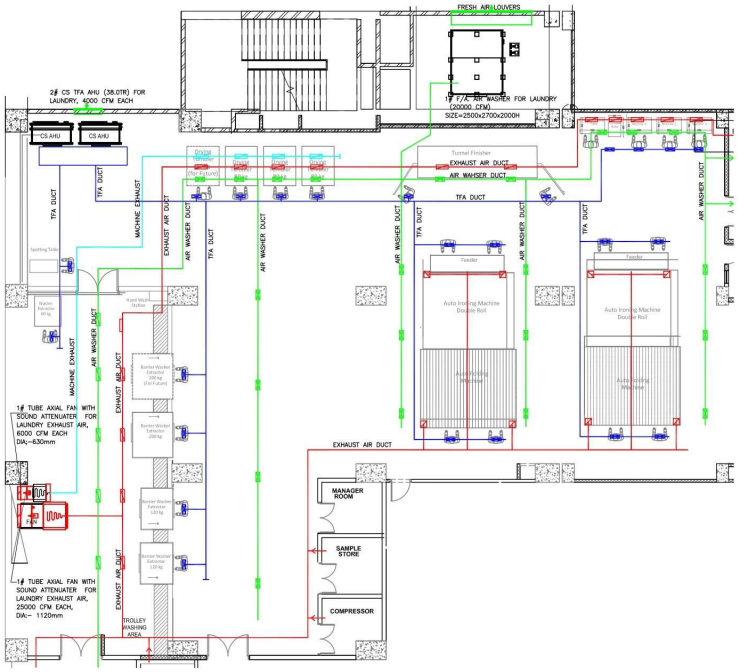
- A Mid-sized Laundry - processing about 4 Tons of linen/ day and occupying an area of approximately 5000 sq.ft, would require around 80-100 RT of Air-condition load, (after taking in account the Heat load from the Washer Extractors, Drying Tumblers, Uniform Presses and Flatwork Ironers), if air-conditioned in a conventional manner.

- The Area Temperature would be around 26^{o}C.

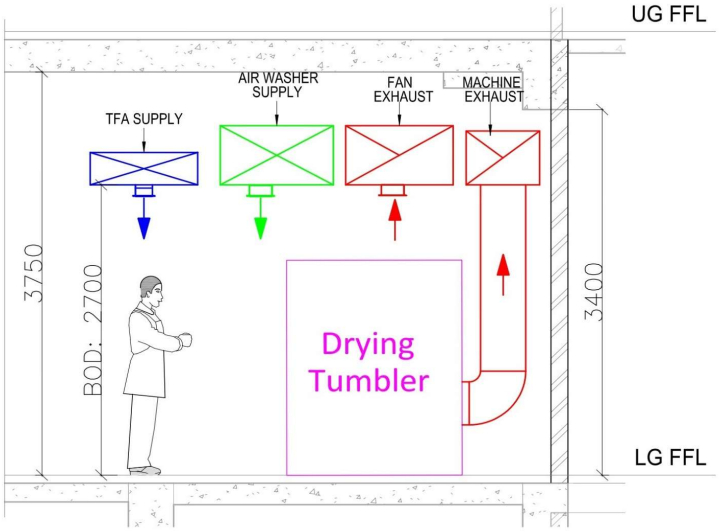
- The same Laundry designed on a **Spot Cooling System** would consume about 25-30 T of A/C load and the staff would be just as comfortable.

Following Slide shows Ducting Layout of Typical
Laundry on Spot Cooling System

The System Design includes:
A) Air Washers
B) TFA (Fresh Air AHU)
C) Exhaust Fans



Typical Section of AIR DISTRIBUTION IN LAUNDRY



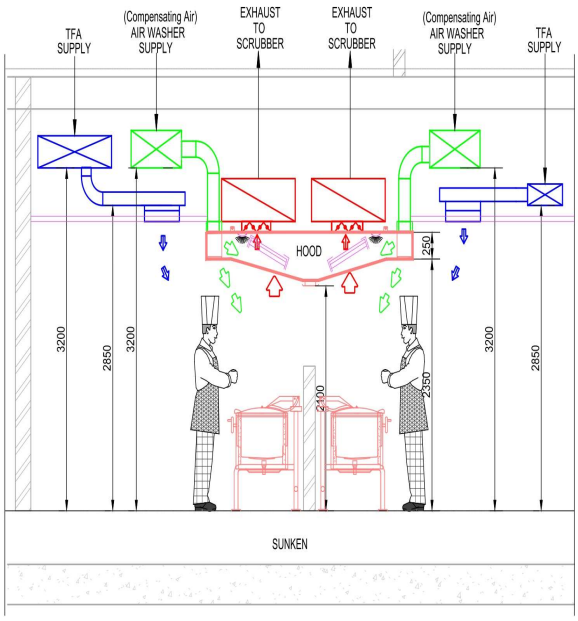
Air distribution Above Flat Work Ironer

Air distribution Above Presses

Air distribution Above Drying Tumbler

Typical Section of AIR DISTRIBUTION IN KITCHEN using Compensating Hood

- Approximately, 80% of the hood exhaust air is compensated by air washers air.
- Approximately 5% of the air supplied by TFA.
- Approximately 10% of the air is from surrounding areas, from above & other Kitchen Equipments.
- Balance 5% of the air is general exhaust, to keep the Kitchen NEGATIVE.



Kitchen - Compensatory Hood Placed above Main Cooking Area

Kitchen – Part Section Showing Exhaust, Compensatory Air and TFA Outlets

Kitchen – Part Section Showing Exhaust, Compensatory Air and TFA Outlets

SAVINGS IN HVAC OF KITCHEN & LAUNDRY OF GRAND HYATT (IREO) GURUGRAM A CASE STUDY

FLOOR & AREA DESCRIPTION	DESIGNED VENTILATION SYSTEM		OPTIMISED VENTILATION SYSTEM BASED ON SPOT COOLING		SAVINGS (TR)
	TFA / AHU Capacity		TFA / AHU Capacity		
	CFM	TR	CFM	TR	
LGF Service Kitchen	19300	164.7	10746	91.70	73.00
LGF Common Kitchen	5500	26.38	5500	26.38	0.00
LGF Staff Kitchen	7800	66.32	3969	33.75	32.57
LGF Campus Kitchen	21300	176.7	6831	56.67	120.03
GF All DD Kitchen	8000	74.71	3267	30.51	44.20
GF Banquet Kitchen	25500	221	14148	123.73	97.27
L-2 Nivasa Kitchen	15900	131.9	4806	39.87	92.03
LGF Laundry	30000	162.6	5867.64	31.80	130.80
TOTAL		**1024**		**434**	**590**

DESIGNED HVAC LOAD – 1024 TR

OPTIMISED HVAC LOAD – 434 TR
(SPOT COOLING)

SAVING IN HVAC LOAD – 590 TR

ANOTHER GOOD OPPORTUNITY FOR COST SAVING

- **Purchasing Solar Power through Open Access**
- **Purchasing Grid Power through 'On-line Trading'**

Next Slide shows Cost Saving, using above two options

SOLAR POWER PLANT

Solar Power – through 'Open Access System'

- These days substantial cost saving can be achieved by purchasing solar power through Open Access System.
- In this system, which is now permitted by the various State Electricity Boards.
- Companies are purchasing/ leasing land and installing large capacity Solar Panels at their cost and are providing and routing the electricity generated through the existing State Electricity Board network.
- The Electricity Board charges for wheeling the electricity, transmission losses, electricity duties, etc. and one can receive solar power at the consumption point.

Grid Power – through 'Online Trading'

The **Indian Energy Exchange** (IEX) is an electronic system based power trading exchange regulated by the Central Electricity Regulatory Commission (CERC).

IEX started its operations on June 27, 2008. Indian Energy Exchange pioneered the development of power trading in India and provides an electronic platform to the various participants in power market, comprising State Electricity Boards, Power producers, Power Traders and Open Access Consumers (both Industrial & Commercial).

IEX is one of the two operational Power Exchanges in India. Ever since its incorporation, it has held an influential market share. IEX operates a day-ahead market based on closed auctions with double-sided bidding and uniform pricing.

COST ANALYSIS IS BASED ON ESTIMATED GENERATION (kWh / Year) = 10068000			
	Open Access (INR/KWh)	**State Electricity (INR/KWh)**	**Power Trading (INR/KWh)**
Commodity Cost (INR/KWh)	3.85	6.85	3.50
Cross Sub-city Surcharge	NA		0.78
Additional Surcharge	NA		0.44
Transmission Charge	0.27		0.27
Transmission Loss (2.06%)	0.10		0.10
Wheeling Charge	0.83		0.83
Wheeling Loss (5.87%)	0.29		0.29
Fuel Surcharge Adjustment Charge	NA	0.37	NA
Banking Charges (Considering 25%)	0.10		NA
Electricity Duty	0.10	0.10	0.10
Municipal Tax	NA	0.15	
SLD Charges	0.02		0.02
Power Trader Margin	NA	NA	0.01
UI Charges	NA	NA	0.10
POC Charges	NA	NA	0.33
Delivered Cost of Electricity (INR/KWh)	**5.56**	**7.47**	**6.77**

Other Opportunities for Energy Savings

Converting Boilers from HSD Fuel System to PNG by Retro-fitting PNG Burner

Payback Analysis - HSD FUEL COST VS PNG FOR 3 TPH STEAM BOILER	
COST OF HSD FUEL CONSUMED / MONTH (INR-LAKHS)	44.03
COST OF PNG CONSUMED / MONTH (INR-LAKHS)	35.32
SAVINGS / MONTH	8.71
COST OF RETROFITTING PNG SYSTEM (Replacement of Burner, Gas Train, Piping, Accessories, etc.) (INR-LAKHS)	12.00
Payback, (No. of Months)	1.38
SAY	**1.5 MONTHS**

STEAM BOILER WORKING ON HSD SYSTEM

HSD FUEL SYSTEM

STEAM BOILER WORKING ON PNG SYSTEM


SAVE
ENERGY
THIS
MEANS
YOU!