

Theoretical Comparative Analysis of Power Consumed in Conventional and Non Conventional Type Air Conditioning System

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Abstract: In this paper a comparative analysis between storage system and non storage system used for air conditioning has been done. An office area of 900 FT³ with 20 TR heating load has been considered for adopting air conditioning system with optimum energy consumption. To ensure the minimize energy consumption two type of system viz. system with storage and second convention system have been selected. Theoretical analysis has been carried out to check the feasibility of employing one of the systems with minimum energy consumption. Detail analysis has been carried out by preparing load profile, comparative plant selection, electrical installation, operating cost comparison and with we see than pay back period is 4 years for storage system.

I. LOAD PROFILE

Cooling load profile has been calculated based psychometric chart in Bombay meteorological condition available in HTP area which is given in figure 1. It is clear from figure that 20 TR Load which is peak in the month of may varies from 12 TR-15 TR .Under such condition employing 20 TR system is not going to be utilized with full capacity in other months of the year.

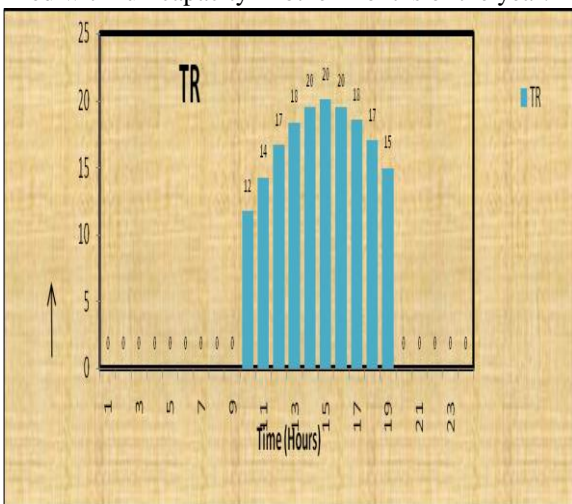


Fig 1: Cooling load Profile of Building

II. SYSTEM DETAILS

Based on Cooling load requirement and time available for charging the storage energy device 10 TR chiller with 120 TRH storage tank has been selected for one system and in conventional system 20 TR refrigeration system has been selected which are given in Table No 1. Thermal

losses during storage has been assumed to negligible. Table 1 is shown in Appendix.

III. CAPITAL COST

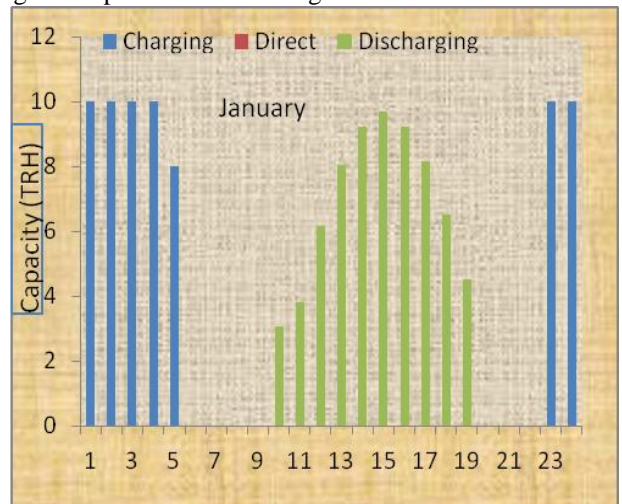
Based on system selected for both option to meet the required cooling load price of screw chiller has been considered which are listed in table No.2(Shown in Appendix). Cost of chiller has been taken viz Rs 15000/TR of cooling capacity and pump cost is Rs 7500/kw, Cooling Tower is Rs 5000/TR.

IV. ANNUAL OPERATING COST ANALYSIS

Monthly operating cost of the storage system and non storage system are given in Table No. 3(Shown in Appendix). Which shows that operating cost of storage system is lower than non storage system? Which become attractive points for this system Maximum demand charges in storage system are lesser than non storage system.

V. OPERATING STRATEGIES

There are four operating strategies adopted in storage system (1) Charging (2) direct load meeting (3) Discharging (4) load meeting and discharging. Amount of energy in every month is indicated in figure No.2-3. Which indicate that maximum storage is utilized in the month of May and in the month of January storage capacity is sufficient to meet the load? Mechanical circuit diagram of plant is shown in figure No.5.



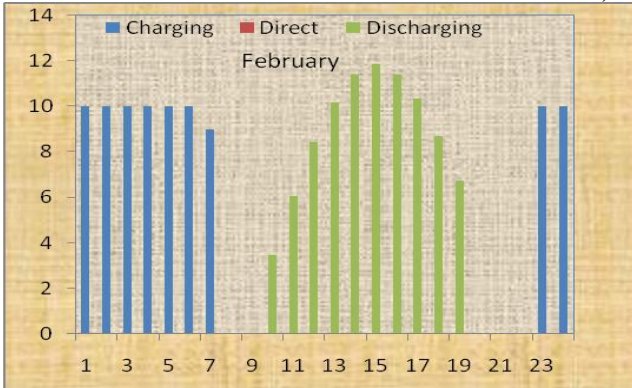
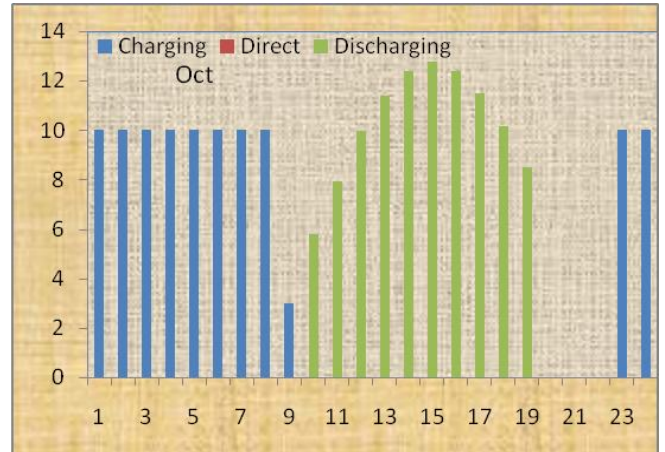
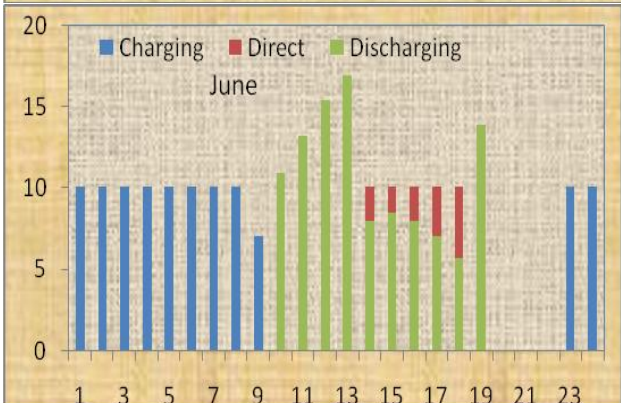
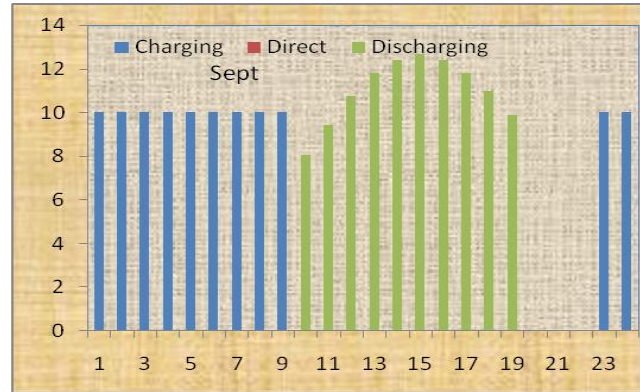
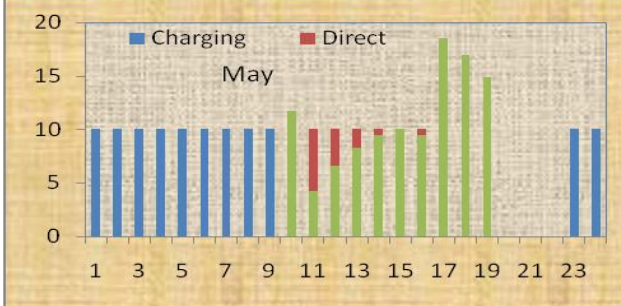
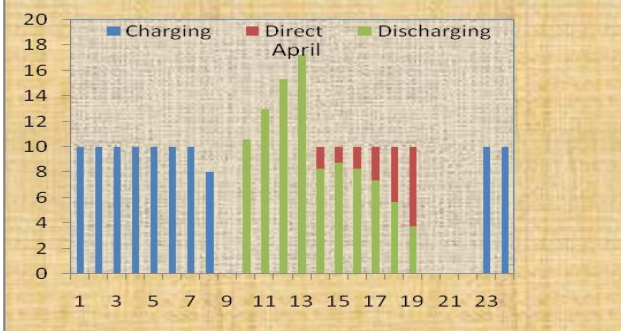
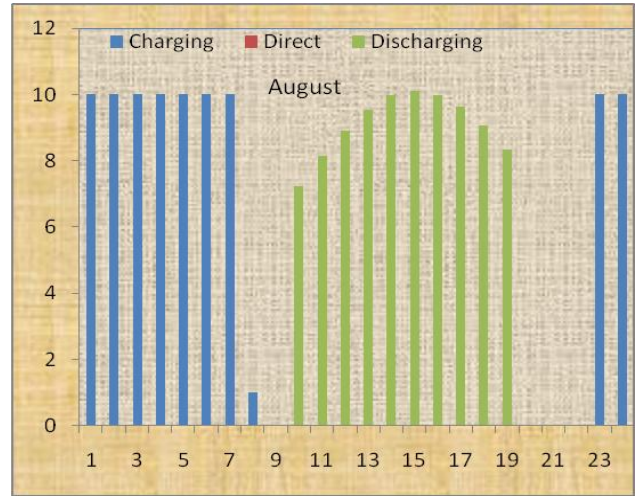
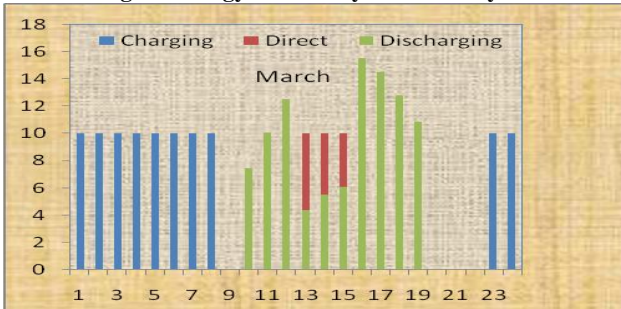
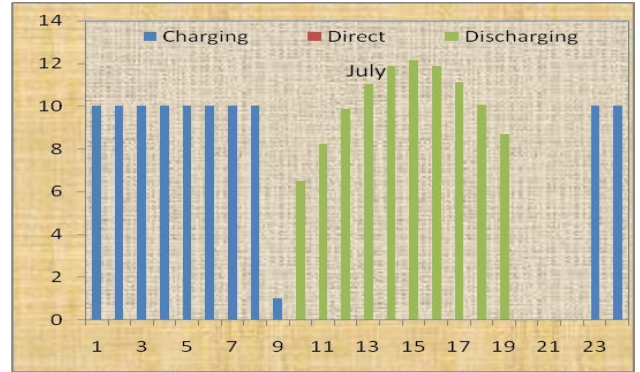


Fig 2: strategy in January & February



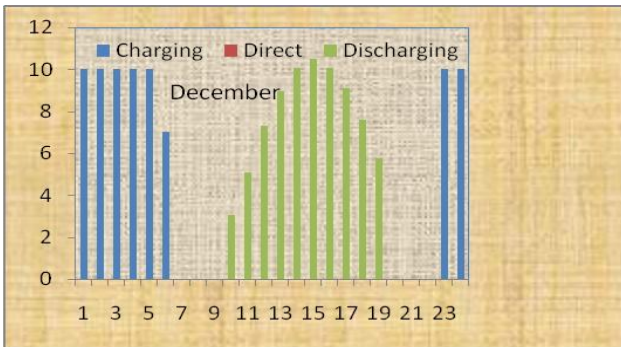
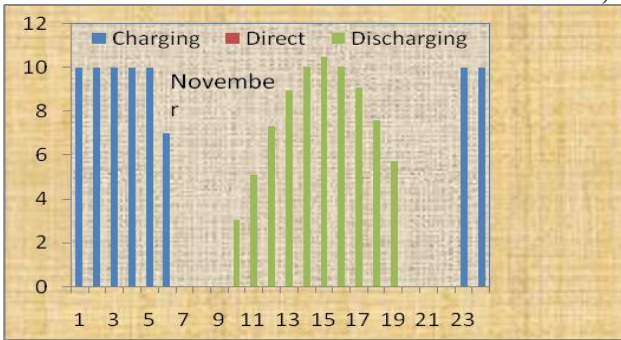


Fig.3 : Strategy in Mar, April, May, June, Jul, Aug, Sep, Oct, Nov & Dec

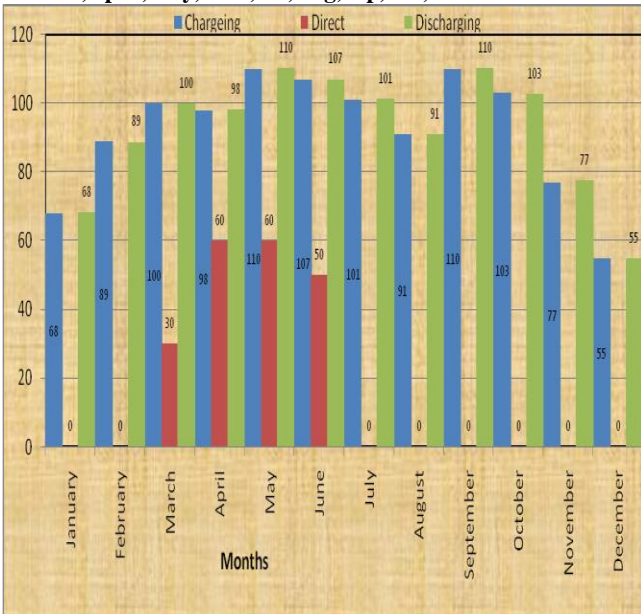


Fig 4: Monthwise charging ,Discharging and Direct load meeting in a year

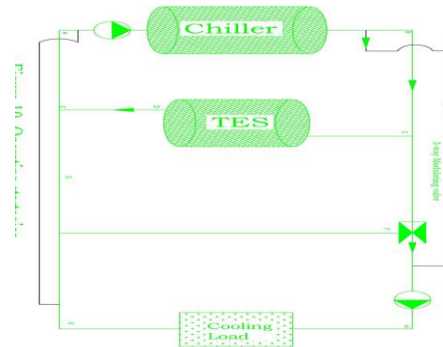


Fig 5: Circuit Diagram showing operation strategies

VI. RESULTS AND DISCUSSION

From above study it is clear that storage system is beneficial at the place where charging time is available. As we can see that total difference of capital cost can be recovered within four years by saving in operating cost of the system. Total saving is 0.62 Lakh per annum and pay back period of total system is four years. It is very clear from figure 4 that maximum storage capacity is being utilized in the month of May.

REFERENCES

- [1] Cristopia Energy System Manual.
- [2] Manual of Screw Chiller LW Series.

S.NO.	Description	Storage System(Non conventional System)			Non storage system(conventional system)		
		Capacity			Capacity		
1	Water cooled centrifugal chiller	Capacity	10	TR	Capacity	10	TR
		Quantity	1	Nos.	Quantity	2	Nos.
2	Thermal Energy Storage System	Volume	8	CUM			
		Capacity	120	TRH			
3	Primary Chilled Water Pumps	Flow	7	CUM/Hr.	Flow	7.0	CUM/Hr.
		Head	10	MT	Head	12	MT
		Quantity	1	Nos.	Quantity	2	Nos.
4	Secondary/Distribution pump	Flow	7	CUM/Hr.			
		Head	22	Mtr			
		Quantity	1	Nos.			
5	Condenser pump	Flow	10.5	CUM/Hr.	Flow	21.0	CUM/Hr.
		Head	12	MT	Head	12	MT
		Quantity	1	Nos.	Quantity	2	Nos.
6	Cooling Tower	capacity	10	TR	capacity	20.0	TR
		Quantity	1	Nos.	Quantity	1	Nos.

Table. 1 Details of System Selection

S.No.	Description	System With Storage(Non conventional) Lakh (Rs)	System without storage(Conventional) Lakh(Rs)
1	Water Cooled Screw Chiller	1.50	3.00
2	Thermal storage Tank (Capacity 120 TRH)	4.80	
3	Chilled water Pump	0.08	0.15
4	Distribution Pump	0.08	0.08
5	Condenser Pump	0.08	0.08
6	Cooling Tower	0.50	1.00
	Total Capital Cost	7.03	4.30

Table 2: Capital Cost Comparison

Months	Storage System		Conventional system		Saving in (Rs)
	Monthly power consumed charges(Rs)	Maximum Demand (KVA)	Monthly power consumed charges(Rs)	Maximum Demand (KVA)	
January	6003	1	6329	9	3999.29
February	7248	8	9418	13	4786.32
March	11767	10	14372	16	5287.81
April	20762	15	23817	27	8343.24
May	18438	12	20271	22	6389.55
June	17988	12	19615	22	5803.47
July	12110	11	14090	16	4302.98
August	10588	11	11277	14	2124.35
September	12229	11	14696	16	5015.30
October	10135	9	12060	15	4405.92
November	7380	1	9414	13	7394.77
December	5065	1	6329	8	4325.47
Yearly Consumption	139713	102	161688	192	0.62 Lakh

Table 3: Annual Operating Cost Comparison