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Achieving Energy Efficiency of HVAC through Variable Frequency Drive

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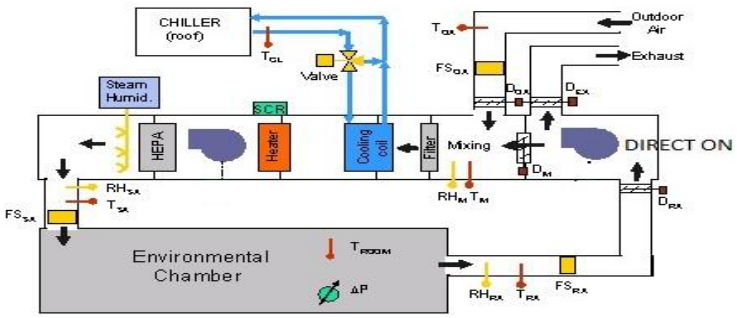
Abstract
The Air Handling units generally consisting Cooling coils (water cooled of DX type) and Heating (Electric or steam) are followed by air filters. The design of air flow calculation is done considering pressure drop filters are about 75 % chock .In actual use when filters are new or replaced the pressure drop is very less and we get high airflow which subsequently increases the Cooling and heating Load on system .If we put a velocity sensor after the filters which input fed PLC (Programmable Logical Controller) ,the motor RPM can be controlled ,saving the excess westage of Energy and pollution
Keywords: *HVAC ,VFD, Energy Efficiency ,control, velocity sensor, DX coil ,heaters ,PLC*

I. Introduction

The Air handling Unit typical is as shown .The sytem consist of a blower a cooling coil a heating coil and filters

The Blower static is calculated by adding 1.Pressure drop across coil , pressure lost in duct run ,and air filters assuming filters nearly chocked



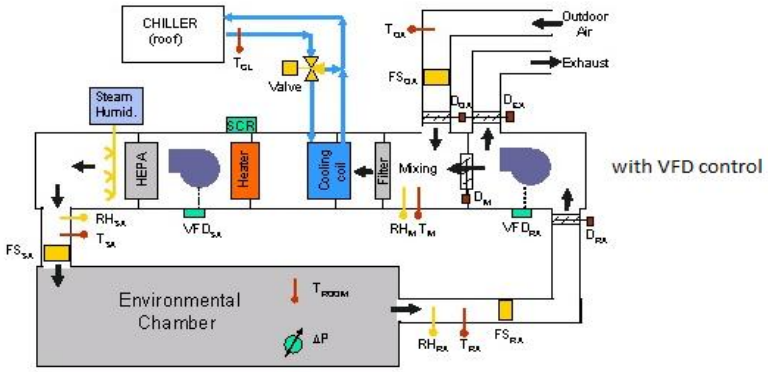
In practice the filters takes large time (period vary from 1 week to 1 year based on type of filter and environment) to come to chock condition .Till this time the pressure drop across filter is low and hence net static pressure drop is quite low compared to design .Hence air flow increases as Fan power P =Density x Gravity x discharge xHead

As Head drops for same Power discharge increases .This additional flow takes up addation cooling load and heating load

II. Suggested Design

An VFD is introduced along with velocity sensor .The sensor will have output 4 -20 ma or 0-10 v for full range of operation

The PLC will have this sensor input and I will have frequency based power output to induction motor



III. Calculation and Design

Design velocity = Design CFM/Duct area In sq m
SET RANGE VALUE IN PLC = DESIGN VELOCITY +/- 10%
As the filters are new the Drop is lesser and cfm becomes high ,the Velocity exceeds set value ,The plc senses the exceed of value (or even reverse phenomenon),it reduces the Frequency of Induction motor the motor RPM reduces and hence
Set velocity achived
Power saved
Scenirio 1 : 10 % velocity reduction ,If P1 is initial power and P2 is power with reduced speed through VFD then
$P2/P1= (N1/N2)^3$
$=(0.9/1)^3$ = @ 72 % means saving =28 %
Scenario 2 20 % velocity reduction saves
P2/P1 1/0.8 3
@51 % Hence POWER SAVING =49%

References

[1] ASHREA Guidelines