

## **Savings Calculations for Savings By Design using a spreadsheet – fume scrubber**

### **Energy Savings Estimation using a generic spreadsheet**

This spreadsheet is used to calculate energy savings on a fume scrubber by using two speed control vs. single speed control. The spreadsheet also calculates energy savings on a make up air handler by using a variable frequency drive (VFD) vs. single speed control.

#### **Fume Scrubber:**

Single speed scenario, assumes 8,760 hours minus 336 down time hours for 8,424 operating hours per year. An 80 percent load factor was applied to the motor along with mechanical efficiencies to determine kWh consumption.

Two speed scenario, assumes 8,760 hours minus 336 down time hours for 8,424 operating hours per year. 1/3 of these hours (2,780 hr/yr) the scrubber will operate at high or full speed. An 80 percent load factor was applied to the motor along with mechanical efficiencies to determine kWh consumption. 2/3 of these hours (5,560 hr/yr) the scrubber will operate at low speed. The two speed motor operates a 15 hp in low speed. An 80 percent load factor was applied to the motor along with mechanical efficiencies to determine kWh consumption. Savings is calculated by subtracting the two speed scenario from the single speed scenario.

#### **Make up air handler:**

Single speed scenario (same as fume scrubber)

VFD scenario, assumes 8,760 hours minus 336 down time hours for 8,424 operating hours per year. 1/3 of these hours (2,780 hr/yr) the make up air handler will operate at high or full speed (15,000 cfm). An 80 percent load factor was applied to the motor along with mechanical efficiencies to determine kWh consumption. 2/3 of these hours (5,560 hr/yr) the make up air handler will operate at 4,000 cfm. The fan law was applied to determine the hp at 4,000 cfm. speed. An 64 percent load factor was applied to the motor along with mechanical efficiencies to determine kWh consumption. Savings is calculated by subtracting the VFD scenario from the single speed scenario.

### **Demand (kW) savings using a generic spreadsheet**

There are no kW savings for this measure.

## Appendix A

Custom Incentive Worksheet							Commercial New Construction		
Compares energy savings from 2 speed and VFD control on make up air handlers and fume scrubbers when compared to single speed control							Contract Number:	62812	
This process is used to exhaust fumes from acid tanks when the lids to the tanks are open. According to the operators the tank lids are open 1/3 of the time. The process operates 24 hours a day, 7 days a week.									
<b>Base Case</b>									
Single speed make up air handlers (2 units) and single speed control on one fume scrubber.									
Make up air handler (Trane T series, Climate Changer)									
Available Hours	Downtime Hours	Operating Hours	No. of units	bhp	motor eff	drive efficiency	Estimated Load	kw/hp	Annual kWh (consumed)
8,760	336	8,424	2	15	91%	97%	80%	0.746	170,866
Fume scrubber									
Available Hours	Downtime Hours	Operating Hours	No. of units	bhp	motor eff	drive efficiency	Estimated Load	kw/hp	Annual kWh (consumed)
8,760	336	8,424	1	60	94.1%	97%	80%	0.746	330,474
<b>Enhanced Case</b>									
VFD on make up air handler (2 units) and 2-speed control on one fume scrubber.									
Make up air handler (Trane T series, Climate Changer) with VFD control									
Available Hours	Downtime Hours	Operating Hours	No. of units	bhp	motor eff	drive efficiency	Estimated Load *	kw/hp	Annual kWh (consumed)
8,760	336	8,424							
Full Speed (1/3 time)		2,780	2	15	91%	93%	80%	0.746	58,735
Low Speed (2/3 time)		5,560	2	15	91%	93%	64%	0.746	94,514
Total									153,249
Fume scrubber with 2 speed control									
Available Hours	Downtime Hours	Operating Hours	No. of units	bhp	motor eff	drive efficiency	Estimated Load	kw/hp	Annual kWh (consumed)
8,760	336	8,424							
Full Speed (1/3 time)		2,780	1	60	94.1%	97%	80%	0.746	109,056
Low Speed (2/3 time)		5,560	1	15	94.1%	97%	80%	0.746	54,528
Total									163,585
<b>Annual Savings</b>									184,506 kWh/yr
<b>Demand Savings</b>									0 kW
1. SDG&E incentive @ \$.08/kWh (process)							\$	14,761	
2. Incremental cost x 50% = ((\$ 8,550 - \$ 3,746)x50%) =							\$	2,402	
<b>SDG&amp;E incentive (smaller of line 1 and 2)</b>									\$ 2,402
* Estimated load on low speed for VFD on make up air handler calculated using fan laws.									
(cfm1/cfm2)^3 = bh1/bh2, (4,000 cfm / 15,000 cfm)^1/3									