H6 ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI) FOR HVAC SYSTEMS

Description of Technology

Microbes are vulnerable to light at wavelengths at or near 2,537 Angstroms (254 nanometers [nm]) due to the resonance of this wavelength with molecular structures. Visible light has wavelengths of about 400 to 700 nm. Ultraviolet (UV) light has wavelengths of 100 to 400 nm. The UV spectrum is further divided into A, B, C, and vacuum bands. The C band is called the germicidal bandwidth and lies between 200 and 280 nm, approximately. Microbes present in HVAC systems are destroyed by UVC and include bacteria, viruses, yeast, mold, and various spores. When applied to the exit face of a cooling coil, UVC has a cleaning effect and can reduce pressure drop as well as improve air quality.

Current Status of Measure

UVGI has been applied in hospitals and prisons since the early 1900s to sterilize the air supply. Application in other, more conventional HVAC systems is more recent. In-duct systems now have 27% of the market. The General Services Administration (GSA) issues standards for public buildings and includes a requirement for UVC downstream of all cooling coils and drain pans (GSA 2003).

Energy Savings and Costs

The energy saving benefit of cleaner cooling coils has only recently been recognized and is still considered to be developing. Typical claims for energy efficiency are a 30% reduction in fan energy and a two-year payback (see http://www.fptechinc.com/Links/UVGItechSum.pdf.). Another typical report comes from Iolani School in Honolulu, a 35,000 ft^2 office and classroom building. It consists of six AHUs totaling 45,000 cfm and used 20 UV lamps total. The lamps last 1.5 years, with a replacement cost of approximately $1,300/year. The installation eliminated mold growth and odor, there were fewer complaints of respiratory problems, and the facility manager is very satisfied. Maintenance savings are estimated at $8,000 per year (Kolderup 2003b).

Key Assumptions Used in Analysis

Because this measure did not demonstrate energy savings, we did no further work on it.

Recommended Next Steps

EPRI will study UVGI as part of its 2004 program, Element P17.005: Demonstrations and Case Studies of Applications of UVGI for Chiller Coils in Commercial Buildings. Results of these investigations may be available to EPRI members. A report is scheduled for March 2005 (EPRI 2003).

H6 Ultraviolet Germicidal Irradiation (UVGI) for HVAC Systems

Description	UV disinfection allows for the use of lower pressure drop filters			
Market Information:				
Market sector	COM			
End-use(s)	HC			
Energy types	ELEC			
Market segment	NEW,RET			
Basecase Information:				
Description	10 ton AHU			
Efficiency				
Electric use		2,461	kWh/year	300 sqft/ton, nat avg fan energy
Summer peak demand		1.4	kW	4000 cfm @ 350W/1000cfm
Winter peak demand		1.4	kW	
Gas/fuel use				
New Measure Information:				
Description	4 UV lamps			
Efficiency				
Electric use		2,215	kWh/year	
Summer peak demand		1.26	kW	
Winter peak demand		1.26	kW	
Gas/Fuel use				
Current status		COMM		
Date of commercialization		1980s		
Life		20	years	DEG estimate
Savings Information:				
Electricity		246	kWh/year	
Summer peak demand		0	kW	
Winter peak demand		0	kW	
Gas/Fuel			MMBTU/year	
Percent savings		10%		
Feasible applications		50%		
2020 Savings potential		1,853	GWh	
2020 Savings potential		19	TBtu (source)	
Industrial savings > 25%		YES		
Cost Information:				
Projected Incre. Retail Cost		$2,000	2003 $	$200/ton
Other cost/(savings)		($600)	$/year	$1000/yr maint savings - $40/ton UVGI O&M
Cost of saved energy		$0.57	$/kWh	Measure justified by impact on IAQ, not on economics
Cost of saved energy		$56.53	$/MMBtu	
Data quality assessment		C	(A-D)	
Likelihood of Success:				
Major market barriers	Knowledge, first cost, lack of documented energy savings			
Effect on utility	Improved IAQ; higher worker productivity			
Current promotion activity	Utility design assistance			
Rating	2		(1-5)	
Rationale	Not cost-effective on energy basis			
Priority / Next Steps				
Priority	Not			IAQ, not energy savings value
Recommended next steps				
Sources:				
Savings	DEG estimate			
Peak demand	DEG estimate			
Cost	Kolderup 2003			
Feasible applications	DEG estimate			
Measure life	DEG estimate			
Other key sources	EPRI 2003, www.fptechinc.com/Links/UVGItechSum.pdf			
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Notes				