Analysis of data given in CEC ventilation study (CEC-500-2009-085, November 2009)

presented on 8/2/2011 at the 15th Annual Westford Symposium by Armin Rudd Building Science Corp

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Context

- California Air Resources Board (CARB) classifies formaldehyde as a toxic air contaminant based on its potential to cause cancer and other adverse health effects.
- Some people can begin to smell formaldehyde at about 50 ppb, but others may not be able to smell it until 500 ppb.
- According to CARB there is no level of exposure to formaldehyde that is known to be risk free.

Source: CARB Indoor Air Quality Guideline, Formaldehyde in the Home, August, 2004.

Context

Email to ASHRAE SSPC 62.2 from Offerman:

"Homes with continuous mechanical outdoor air ventilation systems, such as heat recovery ventilators worked well to increase outdoor air exchange rates and lower indoor air contaminant concentrations, while intermittent mechanical systems interconnected with the forced air heating/cooling system did not perform well."

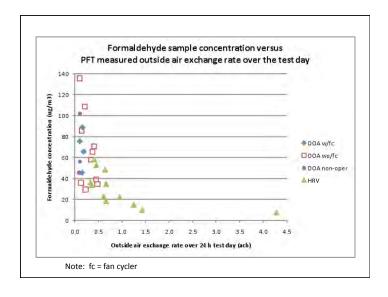
Pg. 8 of CEC report:

"Ducted outdoor air homes had higher formaldehyde concentrations than heat recovery ventilator homes"

Collection of data scattered throughout the report (CEC-500-2009-085, November 2009)

			Summer or early Fall '06 test day									Winter or early Spring '07 test day									
		Auto or									Vent	Vent	Window					Vent	Vent	Window	
Home		Manual	Control/	Operational	OA		Duct	Acetal	HCHO	PFT	on-time	on-time	usage	Exhaust	Acetal	нсно	PFT	on-time	on-time	usage	Exhau
ID	System	Damper	Location	Status	ďm	ACH50	leak %	ug/m³	ug/m³	ACH	hours	fraction	ft ² -h	ACH	ug/m³	ug/m³	ACH	hours	fraction	ft²-h	AC
21	DOA	ad	fc/attic	operational	44	4.14	12.5	58.98	45.42	0.16	9.68	0.40	1	0.02							
99	DOA	ad	fc/attic	operational	10	3.52	5.6								66.58	88.97	0.17	17.88	0.74)
102	DOA	ad	fc/attic	operational	9	4.55	8.9								45.26	75.56	0.11	1.63	0.07)
118	DOA	md	fc/attic	operational	31	5.18	4.4								43.76	65.56	0.19	3,69	0.15	(
4	DOA	md	t-stat/home	operational	28	3.78	7.4	16.61	39.04	0.45	2.81	0.12			62.05	62.83	0.13	1.22	0.05		
8	DOA	md	t-stat/home	operational	71	5.64	4.2	63.43	108.55	0.21	1.95	0.08	92	0.00	67.82	79.20	0.23	2.98	0.12	- 1	2
9	DOA	md	t-stat/home	operational	48	6.14	8.0	24.41	57.73	0.34	6.20	0.26	199	0.03							
10	DOA	md	t-stat/home	operational	27	4.28	5.40	50.67	135.52	0.10	5.63	0.23	42	0.00							
12	DOA	md	t-stat/home	operational	31	4.37	3.80				0.38	0.02	362	0.00							
43	DOA(1)	ad	t-stat/home	operational	8		32.80	22.32	65.52	0.38	1.61	0.07	298	0.00							
	(2)	ad	t-stat/home	operational	27		38.40				4.45	0.19									
58	DOA(1)	md	t-stat/home	operational	49	3.23	9.70	10.08	34.62	0.48	0.00	0.00	1268	0.00	33.75	35.90	0.15	2.19	0.09		
	(2)						10.40														
83	DOA	md	t-stat/home	operational	355	6.20	17.00								21.84	29.62	0.41	1.51	0.06	14	
109	DOA	md	t-stat/home	operational	52	3.97	4.80								101.48	85.71	0.13	0.38	0.02		
110	DOA	md	t-stat/home	operational	63	5.62	5.80				_				15.42	70.73	0.30	0.14	0.01	140	_
16	HRV	na	switch/attic	operational	159	4.93	11.20	4.51	10.07	1.43	24.00	1.00	497	0.51							
17	HRV	na	switch/attic	operational	153	4.58	4.80	2.90	7.80	4.28	24.00	1.00	1114	0.35	6.29	18.55	0.66	24.00	1.00		
18	HRV	na	switch/attic	operational	120	5.30	7.50	5.03	15, 16	1.25	24.00	1.00		0.00	10.02	23.29	0.61	24.00	1.00		
	HRV	na	switch/home	not operated	209			23.16	58,46	0.41		0.00									
	HRV		timer/home	operational	135			16.00	53.00	0.45		0.65	300								
	HRV	na	switch/attic	operational	90		11.10	8.43	22.41	0.95		1.00			16.25	33.87	0.35	24.00	1.00		
	HRV		switch/home		149			13.20	36.70	0.33	7.75	0.32	290	0.17							
	HRV			operational	121	5.49									11.62	48.55	0.64	24.00			
104		na	timer/home	operational	66	7.32	46.60								17.06	35.01	0.66	23.75	0.99		_
iuroe	Tables:																				
			F-13		F-14	F-3	F-7	E-	-15	E-24	F-	14	F-	10	E-	15	E-24	F-	14	F-	-10

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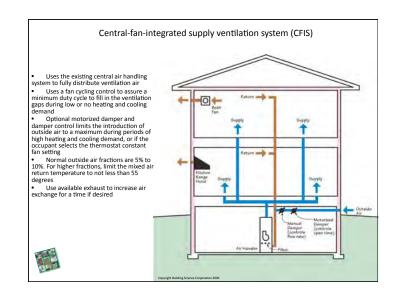


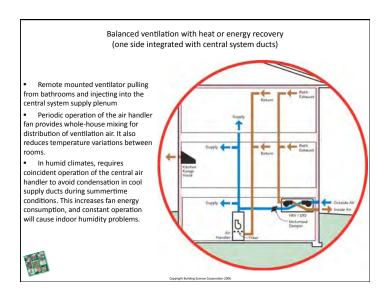
Pg. 65-66 (relative DOA systems)

"Of the 17 homes with DOA systems only six had fan cyclers, four of which had automatic damper controls in the outdoor air duct.

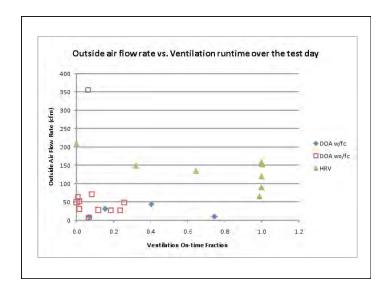
Of the 14 homes with operational DOA systems, only four had fan cyclers, three of which had automatic damper controls in the outdoor air duct.

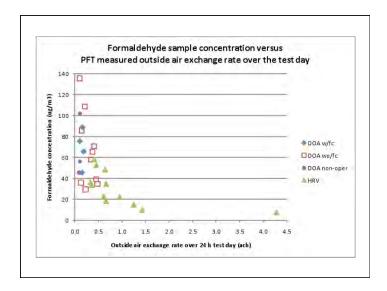
- one FAU fan was never turned on
- one was on for 10 minutes for each 90-minute cycle (i.e., 0.11 fractional on-time)
- one was on for 10 minutes for each 30-minute cycle (i.e., 0.33 fractional on-time)
- one FAU fan ran continuously, while the outdoor air damper opened 55 minutes for each 75-minute cycle (i.e., 0.73 fractional on-time)"

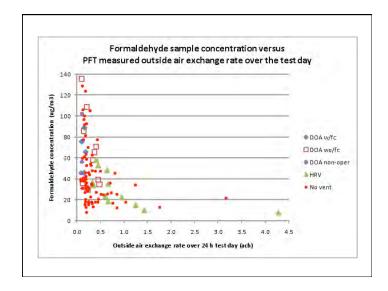


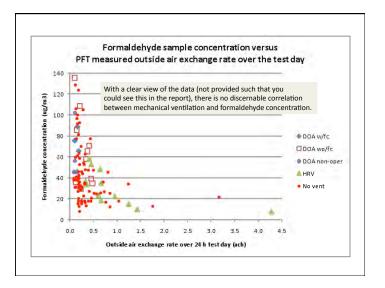


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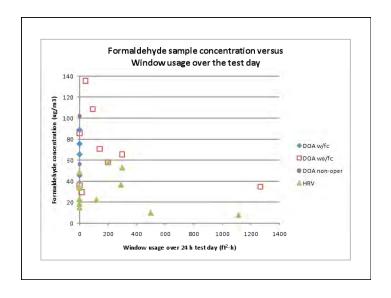


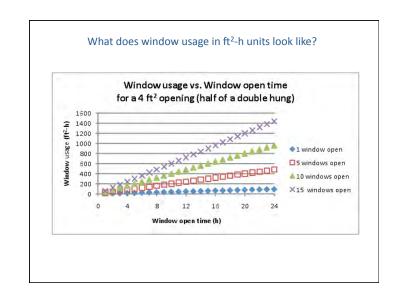


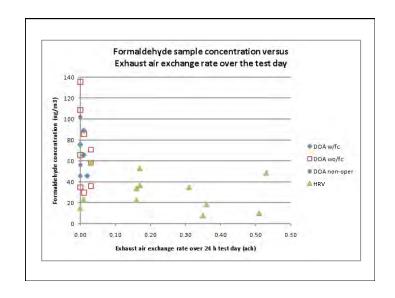


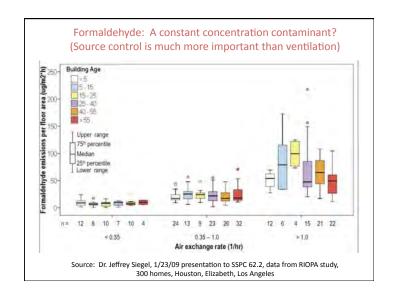


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It's probably not practical to ventilate for formaldehyde

Based on a simple example*:

maximum recommended limit for 8 hour exposure.)

The continuous ventilation rate of a 2000 ft² house would have to be more than tripled (50 cfm to 170 cfm) to reduce formaldehyde concentration from 60 ppb to 27 ppb (27 ppb is the OEHHA -California Office of Environmental Health Hazard Assessment

*Assumptions: Constant source emission rate producing an average concentration of 60 ppb, perfect mixing, and zero outside concentration. Source: Dr. Ren Anderson, 1/28/2006, presentation at USDOE Building America Ventilation Expert Meeting

Conclusions

- Complete and careful reporting of data is important
- Dilution ventilation will not work as a primary method for the control of formaldehyde or other dangerous indoor contaminants
- "The most effective way to reduce formaldehyde in indoor air is to remove or reduce sources of formaldehyde in the home..."*

*Source: CARB Indoor Air Quality Guideline, Formaldehyde in the Home, August, 2004.

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