Permit content

S5.C.9.b.i Allowable Discharges
(f) Air conditioning condensation

"Air conditioning condensation" should be deleted from *allowed* discharges at least for commercial and industrial AC, and apartment buildings with central HVAC. Exception might be made for de minimis individual residence[1] window and heat pump drips directly to ground, not connected to the MS4 or routed to surface water, and without use of any condensate algae control product or other biocide.

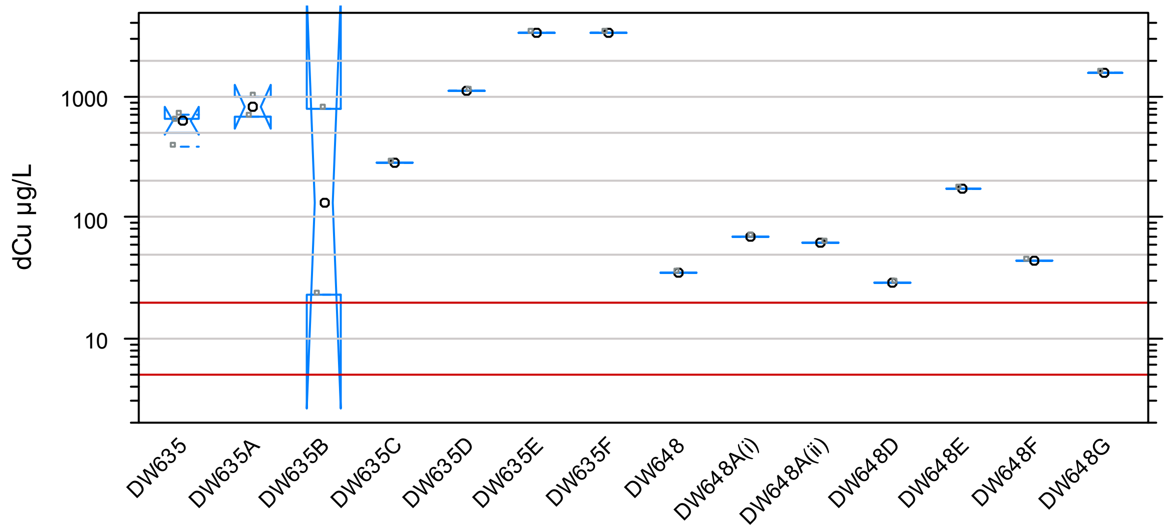
Condensate (the actual substance from condensation) from refrigeration and dehumidification results from the exact same technology and is functionally the same as AC condensate with regard to potential for heavy metals content. If **(f) Air conditioning condensation** is simply removed from **S5.C.9.b.i Allowable Discharges** then there's no need to consider these other uses for the technology. If a de minimis allowance is made, while home refrigerators don't typically discharge any condensate, dehumidification does, so it would be worth including dehumidification in any de minimis allowance.

Condensate can include heavy metals at levels of concern, e.g., depending on installation, copper from condensation coils and drainpipes, lead and/or silver from condensation coil and copper drainpipe solder, zinc from condensate collection pans, microbes, and/or biocides used in condensate collection pans or drain treatment appendages. Depending on installation, any one or more of these pollutants may be present at levels high enough to be of concern absent treatment prior to discharge.

Basis:

- Report from and communications with the City of San Diego
  - Sonksen (2012a). Data memo from City of San Diego (Courtenay White), with note from Sonksen (*ibid*), "IEA stands for Industrial Environmental Association". Memo is attached following **References**.
  - Sonksen (2012b) Results attached to immediately prior email "were all related to AC condensate discharges. The starting point [i.e., the point furthest from the source] is the sample without a letter at the end. As they moved farther up the system the letters increase, as I recall there were some samples that were taken from condensate coming directly off the AC units".
  - Sonksen (2012a) copper sources were traced to air conditioning condensate from large rooftop units (Lilly et al, 2014). Plotted data follow.

[1] This might be extended to duplexes, or even quadraplexes or townhouses with individual air handling facilities, but should not be granted to apartments or condominiums.



Copper source identification traced to HVAC. Data taken from San Digeo date per Sonksen (2012a) and plotted here. For perspective, the red lines are WA Ecology TAPE untreated influent lower and upper bounds for dissolved copper (dCu). Boxplots with 95% CIs are only possible when more than one sample was collected at a site; amount of variablity around single-sample points cannot be estimated. As noted above, for each of DW635 and DW648, sampling is left to right, furthest from the source of the copper toward the source.

- Center for Watershed Protection: Lilly et al. (2014) MD sampling. ". . . street-level inspection to look for rooftop discharges that outlet to the sidewalk, street, or storm drain system", "Suspected HVAC discharge". Narrative says Cu and Zn laboratory analyses are for dissolved fractions.
  - " water quality samples collected from A/C condensate by the Center for Watershed Protection (2012) were 1.9 to 7.4 mg/L for ammonia using field tests, and total nitrogen concentrations ranged from 3.8 to 7.0 mg/L based on laboratory analysis." Assessment as to whether results would exceed WA WQS would be time consuming, given the complexity of the criteria; not attempted here.
  - Metals data from Table 3
    - Cu: field mean/median/max/SD = 100/NA/1000/300 µg/L. [2]
    - Cu: lab mean/median/max/SD = 1400/300/6000/2300 µg/L
    - Zn: lab mean/median/SD = 1300/700/4800/1500 µg/L.[1]
- Conveying information from other studies, Lilly et al (*ibid*) reported:
  - "M. Raber (water quality specialist, City of Durham, North Carolina, pers. comm., April 26, 2013) reported concentrations of copper in A/C condensate as high as 175 µg/L and concentrations of zinc as high as 350 µg/L in A/C condensate."
  - "In a water quality analysis of A/C condensate, Kant et al. (2012) found copper concentrations from 0.04 to 1.69 mg/L and zinc concentrations up to 1.19 mg/L".
  - Qualitative statement, i.e., no values given with this narrative: "Multiple localities in the Chesapeake Bay region have also reported contamination from HVAC discharges, including Fairfax County, Virginia (A. Smith Young, code specialist II, Fairfax County, Virginia, pers. comm.,

[2] From Table 3. Table-reported median of 0 is highly suspect as an erratum.

May 1, 2013), and Baltimore City, Maryland (M. Schlenoff, pollution control analyst II, City of Baltimore, Maryland, pers. comm., May 8, 2013)".

- Data from San Diego noted, i.e., same as in (Sonksen 2012a, 2012b) noted above.

Additional results from recent literature search

Glawe (2013) Qualitative statements indicative of pollution potential:

"The condensate contacts metals along the flow path such as cooling coils, drain pans, pipes, valves, meters, tanks, and other appurtenances. The acidic nature of the condensate prompts reactions with metals, especially iron and steel, to form metal ions (Alliance for Water Efficiency 2012)[3]. In the vast majority of cases, the trace concentration of metals in the condensate is inconsequential[4].

"However, under limited circumstances, the metals can accumulate to toxic levels. For example, metals could be a concern when using condensate piped through metal pipes for irrigation, since metals could build up in the soil to a toxic level over a long period of time. If the chosen application is sensitive to metals, design the system to minimize the exposure of condensate to bare metal components along the condensate flow path."

"When cleaning the AHU cooling coils, divert the wastewater to an appropriate disposal path to prevent excess metals (e.g., copper from the cooling coils), dirt, microorganisms, and cleaning solvents from contaminating the reclaimed water."

Glawe et al. (2016) Data:

Table 1:
Chemical contaminants in condensate samples in parts per million (ppm or mg/L)
Converted here to µg/L

Cu:	n = 13	Range = 16 to 1,340	Average = 230
Zn:	n = 15	Range = 18 to 267	Average = 180

[3] Unable to obtain this document for confirmation or to see if it contains empirical data.

[4] Most of the time when this kind of statement is made it is in relation to drinking WQS, which are orders of magnitude higher than aquatic SWQS for Cu and Zn. Also note that the examples given here are only "iron and steel". Absent qualification as to applicability, the term inconsequential should be viewed skeptically. Further, Glawe et al. (2016) Data which follow above indicate Cu and Zn at elevated levels of concern.

Jurga et al. (2023)

"water chemistry results showed the presence of both metals and organic compounds."

Table 5 [Cu and Zn – unspecified re: total or dissolved, but as condensate content one might assume dissolved]. Condensate quality and composition data gathered from systems generating condensate from ambient air [µg/L]

	Cu	Zn
• Alipour et al. [43]	--	--
• Al-Farayedhi et al. [44]	19	--
• Reuter [45]	--	283[5]
• Glawe et al. [38,39][6]	230	180
• Siam et al. [46]	968[7]	213[8]

- Reuter (2016)

  Table 18: HVAC Condensate ICP and ICP-MS analysis results

  Units = µg/L All samples filtered (0.45 µm filter) before analysis

Cation	Unit A	Unit B	Unit C
Copper	1,552	993	97
Zinc	596	205	49

"Unit C usually had the lowest concentration of any given cation indicating it was either less corrosive, the coil and/or metal collection system was more corrosion resistant, or the condensate was in contact with the coil and/or metal collection system for less time. Unit C condensate could have been less corrosive since it had the highest pH of all condensates (Table 15)."

HVAC condensate pan and drain products that contain biocides which may be toxic to aquatic life. A cursory search for such information yielded these, which even absent further research indicate pollutant potential that should be taken into consideration. For example, but not limited to:

- Algae Guard https://hvacmaintenanceproducts.com/algae-guard/
  SDS https://hvacmaintenanceproducts.com/wp-content/uploads/2018/04/ALGAE-GUARD-SDS-01-25-2016.pdf
- Rectorseal Drain Guard https://rectorseal.com/drain-guard/
  SDS https://bit.ly/35Joeu1
- Any number of other biocide products for this application

[5] +/- 230
[6] Values from already cited Glawe et al. (2016). These are averages. Ranges were: Cu: 16 to 1,340 µg/L and Zn: 18 to 267 µg/L.
[7] +/- 638
[8] +/-205

References

Glawe, Diana D. 2013. San Antonio Condensate Collection and Use Manual for Commercial Buildings. San Antonio: San Antonio Water System.: Trinity University.

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Jurga, Anna, Anna Pacak, Demis Pandelidis, and Bartosz Kaźmierczak. 2023. Condensate as a water source in terrestrial and extra-terrestrial conditions. Water Resources and Industry 29:100196.

Lilly, Lori A., Neely L. Law, Alexander Torella, Daniel McCann, and Pamela Parkerd. 2014. Pollutant Analysis of HVAC Discharges in Montgomery County, Maryland. In Watershed Science Bulletin. February 2014 Issue: Center for Watershed Protection. https://owl.cwp.org/mdocs-posts/pollutant-analysis-of-hvac-discharges-in-montgomery-county-maryland/

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Sonksen, Andre. 2012a. RE: Air Conditioner Condensate study - City of San Diego Transportation & Storm Water Department. Personal communication (email).

Sonksen, Andre. 2012b. RE: Air Conditioner Condensate study (2) - City of San Diego Transportation & Storm Water Department. Personal communication (email).

To Whom It May Concern:

The following table summarizes the results of three recent ICID investigations by Stormwater Department Biologists. All three involved exceedances of dissolved copper. DW635 and DW648 were traced to air conditioning condensate from large rooftop units.

Site ID	**Receiving Water**	**Sample Date**	**Result, dissolved hardness**	**CTR's maximum copper, based on hardness of sample**	**Result, dissolved copper**	**Exceedance (factor by which sample is overlimit)**
DW212	San Diego Bay (Chollas)	09/15/2008	22mg/l	4.3ppb	34ppb	7.9
DW212A	San Diego Bay (Chollas)	09/15/2008	3.3mg/l	1.5ppb	29ppb	19.3
DW635	San Dieguito River	07/29/2008	540mg/l	65.8ppb	390ppb	5.9
DW635	San Dieguito River	08/13/2008	520mg/l	63.5ppb	700ppb	11
DW635	San Dieguito River	09/16/2008	440mg/l	54.3ppb	630ppb	11.6
DW635A	San Dieguito River	08/13/2008	510mg/l	62.4ppb	680ppb	10.9
DW635A	San Dieguito River	09/16/2008	130mg/l	17.2ppb	990ppb	57.6
DW635B	San Dieguito River	08/13/2008	320mg/l	40.2ppb	780ppb	19.4
DW635B	San Dieguito River	09/16/2008	220mg/l	28.2ppb	23ppb	None
DW635C	San Dieguito River	09/16/2008	19mg/l	2.9ppb	280ppb	96.5
DW635D	San Dieguito River	09/16/2008	140mg/l	18.5ppb	1100ppb	59.5

DW635E	San Dieguito River	09/16/2008	Non Detected	1.5ppb	3400ppb	2266.6
DW635F	San Dieguito River	09/16/2008	Non Detected	1.5ppb	3400ppb	2266.6
DW648	Mission Bay	08/19/2008	96mg/l	13.4ppb	35ppb	2.6
DW648A(i)	Mission Bay	09/04/2008	1.3mg/l	1.5ppb	70ppb	46.6
DW648A(ii)	Mission Bay	09/08/2008	1.8mg/l	1.5ppb	62ppb	41.3
DW648D	Mission Bay	09/16/2008	240mg/l	30.7ppb	29ppb	None
DW648E	Mission Bay	09/16/2008	3.7mg/l	1.5ppb	170ppb	113.3
DW648F	Mission Bay	10/07/2008	0.38mg/l	1.5ppb	44ppb	29.3
DW648G	Mission Bay	10/07/2008	Non Detected	1.5ppb	1600ppb	1066.6

Any questions regarding these investigations can be directed to myself or any of the other Biologists in the city's Stormwater Pollution Prevention Department.

Sincerely,

Courtenay White