Technical Bulletin 181

Higher Vinegar Concentration for Descaling Rinnai Products

Purpose: This Technical Bulletin communicates the use and proper mixing ratios to use concentrated vinegar solutions up to 45% to dilute with water to make a final vinegar solution of 5% that is used for descaling Rinnai products.

IMPORTANT

- Do not use vinegar solutions exceeding 5% concentration to descale Rinnai products. Always dilute concentrated vinegar solutions to 5% using mixing ratios provided in Table 1 (next page).
- Do not use concentrated vinegar solutions exceeding 45% to dilute with water to make a 5% vinegar solution.

PRODUCT INFORMATION

Applicable Products:

- Rinnai Tankless Water Heaters
- Rinnai I-Series Condensing Combination (Combi) Boilers

DETAILS

The typical concentration of vinegar recommended to descale Rinnai products and available in stores is around 5%. Higher concentrations of vinegar are also available.

When handling and using concentrated vinegar solutions, always refer to the manufacturer's Material Safety Data Sheet (MSDS) for proper handling and precautions. Appendix A provides an example MSDS for a 45% concentrated vinegar solution. Note: The main ingredient of vinegar solution is Acetic Acid.

⚠ CAUTION

Concentrated vinegar is corrosive and can cause severe skin burns and eye damage. Therefore, when handling concentrated vinegar solutions, it is essential to keep the following critical safety precautions in mind:

- Always wear protective clothing and eye/face protection (gloves and safety goggles). Do not allow the solution to come into contact with your skin.
- Always keep concentrated vinegar away from sources of heat, sparks or flame.
- Do not add water to concentrated vinegar solutions. When diluting concentrated vinegar solutions, add the concentrated solution into water to mix it in.
- Keep away from children and pets. Do not store where children can access it.
- Use only in well-ventilated area or outdoors.
- Do not breathe vapors or mist.
- Do not eat, drink or smoke when handling concentrated vinegar solutions.

⚠ WARNING

IN CASE OF EMERGENCY:

- Eye contact: Immediately flush the eye with plenty of water. Continue for at least ten minutes and call for immediate medical help.
- Skin contact: Wash off with plenty of water. Remove any contaminated clothing. If the skin reddens or appears damaged, call for medical aid.
- If swallowed: Drink plenty of water and call for immediate medical help.

MIXING DIRECTIONS

Carefully add the proper amount of concentrated vinegar solution into water amounts as shown in Table 1 and mix thoroughly.

Table 1: Mixing Ratios Using Concentrated Vinegar Solution and Water. Mixing Rations are Provided to Make a 4-gallon of 5% Vinegar Solution Used for Descaling.

		In Gallons		In Liters		
		Concentrated Vinegar	Water	Concentrated Vinegar	Water	
Vinegar Concentration	10%	2.0	2.0	7.6	7.6	
	15%	1.3	2.7	5.0	10.1	
	20%	1.0	3.0	3.8	11.4	
	25%	0.8	3.2	3.0	12.1	
	30%	0.67	3.33	2.52	12.62	See Example 1 Below
	35%	0.57	3.43	2.16	12.98	
	40%	0.50	3.50	1.89	13.25	
	45%	0.44	3.56	1.68	13.46	See Example 2 Below

Example 1: Referring to Table 1, using a 30% concentrated vinegar solution:

Carefully add 0.67 gallons (2.52 liters) of 30% concentrated vinegar solution into 3.33 gallons (12.62 liters) of water and mix thoroughly. This will provide a 4-gallon vinegar solution with a concentration of 5%.

Example 2: Referring to Table 1, using a 45% concentrated vinegar solution:

Carefully add 0.44 gallons (1.68 liters) of 45% concentrated vinegar solution into 3.56 gallons (13.46 liters) of water and mix thoroughly. This will provide a 4-gallon vinegar solution with a concentration of 5%.

Appendix A: Example MSDS for a 45% Concentrated Vinegar Solution

1. IDENTIFICATION

IDENTIFIER (AS LABELED): 45% Pure Vinegar – Concentrated Industrial Grade (1 gallon)
RECOMMENDED USE/RESTRICTION: Cleaning, Home, Automatic
MANUFACTURER'S NAME: Belle Chemical
ADDRESS: 501 N. 22nd. St.
Billings, MT 59101
EMERGENCY PHONE: Belle Chemical LLC (406) 672-5899 [24hr]
BUSINESS PHONE: 877-522-2233

Health	2
Fire	0
Reactivity	0

2. HAZARD(S) IDENTIFICATION

HAZARD CLASSIFICATION: Skin Corrosion (1B)
Eye Damage (1)
SIGNAL WORD: Danger
HAZARD STATEMENT(S): Causes severe skin burns and eye damage. Harmful if swallowed.

SYMBOL(S):
PRECAUTIONARY STATEMENT(S): Do not breathe mist, spray or vapors. Wash exposed skin thoroughly after handling. Wear protective clothing when handling the product. If swallowed: rinse mouth and seek medical attention. If in eyes or on skin: Rinse area with plenty of water. Remove contact lenses if present and easy to do. Continue rinsing. Seek medical attention after rinsing eyes, even if symptoms do not occur. If inhaled: remove to fresh air and keep comfortable for breathing. Call a physician or poison control.
HAZARDS NOT CLASSIFIED: Not Applicable
UNKNOWN ACUTE TOXICITY: Not Applicable

3. COMPOSITION/INFORMATION ON INGREDIENT(S)

CHEMICAL NAME	CAS #	% w/w	EXPOSURE LIMITS IN AIR					
			NIOSH		OSHA			NIOSH
			TLV TWA	STEL	PEL	STEL	IDLH	REL
Vinegar	64-19-7	44-48	10 ppm	15 ppm	10 ppm	15 ppm	50 ppm	50 ppm

4. FIRST-AID MEASURES

INHALATION: Remove person to fresh air and keep comfortable for breathing. If irritation persists, contact POISON CONTROL or seek medical attention.
EYES: Hold eyelids open and flush with a steady stream of water for 20 minutes. Seek medical attention after rinsing.
SKIN: Wash affected area with soap and water. Contact POISON CONTROL or seek medical attention if irritation arises or persists.
INGESTION: Rinse mouth and immediately transport for medical attention. **DO NOT INDUCE VOMITING** unless directed by a medical professional. Call POISON CONTROL.

5. FIRE-FIGHTING MEASURES

SUITABLE EXTINGUISHING MATERIALS: Use extinguishing media applicable to the surrounding fire. Recommended to use fine water spray, normal foam or dry agent (carbon dioxide, dry chemical powder).
SPECIAL EQUIPMENT: Use water spray to cool containers. Wear full protective clothing and self-contained breathing apparatus (SCBA).
SPECIFIC HAZARDS: When heated to decomposition, this product may emit toxic fumes and carbon oxides.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Shut off all possible sources of ignition. Contain material and absorb with inert material. In some cases dilution with significant water may be required. Neutralization may be effective to stabilize large contained spills. Dispose of according to Federal, State and local regulations. Do not allow concentrated material to discharge into controlled waterways; contact local authorities. Wear PPE according to Section 8.

7. HANDLING and STORAGE

SAFE HANDLING: Wash hands after handling material. Do not eat, drink, or smoke while handling material. Do not get in eyes.
SAFE STORAGE: Store in cool, dry, well-ventilated area away from incompatible materials.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

ENGINEERING CONTROLS: Use with adequate ventilation
RESPIRATORY: NIOSH-approved respirator
EYE: Face shield and goggles

HAND: Hand protection made of compatible material **BODY:** Appropriate for exposure or work environment
OTHER PROTECTIVE MEASURES: Eye wash fluid should be accessible in case of eye irritation due to exposure

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Clear amber liquid	**ODOR:** Vinegar	**ODOR THRESHOLD:** 0.21 to 1.0 ppm
PH: ≤ 2.35 (1M solution)	**MELT/FREEZE POINT:** ~32°F	**BOILING POINT/RANGE:** 244°F
FLASH POINT: 119°F (Closed Cup)	**EVAPORATION RATE:** Not Established	**FLAMMABILITY:** Not Established
UEL / LEL: Not Established	**VAPOR PRESSURE:** Not Established	**VAPOR DENSITY:** Not Established
RELATIVE DENSITY: ~1.02	**SOLUBILITY(IES):** Water	**PARTITION COEFFICIENT:** Not Established
AUTO-IGNITION: Not Established	**DECOMPOSITION TEMP:** Not Established	**VISCOSITY:** Not Established

10. STABILITY AND REACTIVITY

REACTIVITY: No specific test data related to reactivity available for this product or its ingredients.
CHEMICAL STABILITY: Stable under normal conditions
CONDITIONS TO AVOID: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.
INCOMPATIBLE MATERIALS: Strong oxidizers, acids and bases
HAZARDOUS POLYMERIZATION: Will not occur

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION: Toxic to animals and marine life from pH modification.
NTP/IARC SUSPECTED CARCINOGEN: Not suspected.
SYMPTOMS OF EXPOSURE: Pain, watering, redness in eyes. Respiratory tract irritation and coughing. Skin pain, irritation and blistering. Stomach pains if ingested.

TOXICITY ESTIMATE(S):	DERMAL (RAT):	1,060	mg/kg
	ORAL (RAT):	3,310	g/kg
	INHALATION (RAT):	11,000	mg/m^3

12. ECOLOGICAL INFORMATION

ECOTOXICITY: Toxic to aquatic life.

EC50 (Algae, 96hr):	73,400	µg/L
EC50 (Daphnia, 48hr):	65,000	µg/L
LC50 (Crustaceans, 48hr):	50.1	µg/L
LC50 (Fish, 96hr):	75,000	µg/L

PERSISTENCE AND DEGRADABILITY: Biodegradable
BIOACCUMULATIVE POTENTIAL: Product is biodegradable.
$LogP_{ow}$ = -0.17
BCF = 3.16
MOBILITY IN SOIL: Not tested as a whole
OTHER ADVERSE EFFECTS: May cause adverse pH modification in aqueous ecological systems

13. DISPOSAL CONSIDERATIONS

SAFE HANDLING AND DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations.

14. TRANSPORTATION INFORMATION

UN NUMBER/SHIPPING NAME: UN2790/ACETIC ACID (NOT FULLY REGULATED)
TRANSPORT HAZARD CLASS(ES): 8 (NOT FULLY REGULATED)
DOT: NOT REGULATED
PACKING GROUP: III
ENVIRONMENTAL HAZARDS: No
TRANSPORT IN BULK: Stow separated from bases, oxidizers, sources of heat or ignition.
SPECIAL PRECAUTIONS: None

15. REGULATORY INFORMATION

SARA 302: No requirements.
SARA 311/312: Acute
SARA 313: No requirements.
TSCA STATUS: All constituents.
CALIFORNIA PROPOSITION 65: Not found.
CERCLA (RQ): Acetic Acid (5000-lbs.)
STATE REGULATIONS: Acetic Acid: MA, NJ, NY, PA, RI
WHMIS: Constituents of this product are listed on EINECS
EUROPEAN INVENTORY: Constituents of this product are listed on EINECS

16. OTHER INFORMATION

The information and recommendations herein are taken from data contained in independent industry recognized references including NIOSH, OSHA, ANSI, and NFPA. No guarantee, express or implied, and no liability is assumed by Belle Chemical in conjunction with the use of this information.

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