Best Practices for Kiln Management

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Safety Recommendations

Kilns are high temperature thermally insulated furnaces or ovens used to burn, bake or dry raw clay. Kilns are usually insulated with ceramic fiber material (CFM) or firebricks and require programming, loading, unloading, cleaning, monitoring, and servicing. The many hazards that may be encountered when operating kilns include:

1. Inhalation of toxic fumes (from all types of kilns and smoke from sawdust kilns), which can include sulfur oxides, nitrogen oxide, fluorine, chlorine, carbon dioxide, and carbon monoxide.
2. Inhalation of or contact with fibers from kiln insulation material and clay or ceramic glaze dusts must be reviewed to ensure exposure does not exceed any permissible exposure limit as identified under Cal-OSHA regulatory framework.
3. Contact with hot equipment and materials resulting in burns.
4. Contact with sharp pieces of broken projects resulting in lacerations.
5. Fire
6. Electrical/gas supply

When selecting a kiln for a classroom, careful consideration should be given to location, installation, testing, ongoing maintenance, training of the individual using the kiln and general operation of the kiln. Operation of the kiln may include, use of personal protective equipment (PPE), selection and knowledge of material being used and/or being fired in the kiln. Best practices in this document, regular teacher safety training (i.e. Public School Works), local building codes, local fire inspector guidelines, and manufacture guidelines should ensure the safe use of a kiln in a classroom environment.

Raku firing is not recommended in a K-12 classroom. Raku firing is a process in which the clay is removed from the kiln at a high temperature (>1700 degrees) and then post fired reduction by placing in containers of combustible materials which blackens the clay and creates a crackling in the glaze surface.

Regarding students' use of kilns, careful consideration should be given to the age and ability of the student. Appropriate training for kiln firing practices and operations should be given. Students must always be under the direct supervision of a teacher.

Location and Construction

Careful consideration should be given to placement and construction of a kiln. The area should be well ventilated, free of hazard and follow all guidelines via the manufacturer, local building code, fire inspector guidelines. Ideally a kiln should not be used in a classroom; if this is unavoidable ensure there is a barrier around the kiln to prevent students from getting too close to the kiln. In addition, warning signs should be placed indicating high heat or burn hazards.

Additional information on locations

1. Kilns should not be operated in classrooms.
    a. Sheds that are properly designed for kilns have been used with success.
    b. Unused custodial closets may be used if no other supplies are stored in the same closet, if they meet code requirements, requirements in this documentation, and maintain a minimum of 36" from combustible material
2. Controlled access – lockable
3. Visual access from the outside
4. Large enough for kiln-related materials only

5. Hard wired electrical supply available in accordance with local electrical and fire safety codes and in accordance with manufacturers' suggested installation instruction. Installation must be performed by a qualified electrician.
6. Easily accessible with no obstructions to allow for air flow, maintenance and servicing.
7. Compliance with Title 5, California Code of Regulations – School Facility (CA Dept. of Education) is essential. Kiln should be in a safe, properly wired and ventilated area.
8. The kiln should either be outdoors or properly vented to the outside. Follow the kiln manufacturer's instructions and use trained heating, ventilation and air-conditioning (HVAC) personnel for proper installation and compliance with the California Building Code, Fire Code and the Uniform Mechanical Code.
9. The room should be accurately tested, and the adequacy of the system's ventilation documented using proper testing equipment.
10. New rooms being constructed as Kiln rooms are to be constructed with wall materials rated for two-hour fire protection, per the California Building Code.
11. Existing rooms undergoing conversion to Kiln Room use should have walls finished with a layer of 5/8-inch type X drywall and should be in sound physical condition, without unprotected penetrations or openings.
12. The classroom should contain only kiln-related items. The classroom should be for kiln use only; no other class activity should occur in the same room.
13. The classroom should be free of obstructions and able to be easily accessed.
14. Art supplies can be stored under certain conditions as follows:
    a. A minimum distance of 18" must be maintained from noncombustible surfaces and 36" from combustible surfaces.
    b. No combustible materials can be stored on kiln at any time.
    c. No flammable paints, solvents or aerosols may be stored in the kiln room at any time.

Installation and Electrical Management

A kiln should be wired to a separate, fused, disconnect box with a lockout provision to allow the kiln to be disconnected and prevent unauthorized use. If a kiln cannot be directly wired, it should be plugged into an adequately rated and protected socket.

Additional safety information

1. Follow all the manufacturer's instructions for installation. Always observe fire, building, DSA and safety codes when installing any product.
2. Ensure the kiln is installed on level non-flammable flooring and use the manufacturer supplied stand. Position the kiln at least 12-18 inches from the wall, floor or ceiling.
3. Ensure there is adequate spacing around the kiln for maintenance, service and air flow.
4. Kilns should be in a dry place to prevent electrical shock and corrosion.
5. Kilns should be in a protected area, away from foot traffic.
6. Ventilation is key to maintaining a healthy work environment and proper room temperature. Proper installation of vent will clear potentially harmful fumes from the room. To ensure proper room temperature is maintained, consult a qualified HVAC professional.
7. Be careful of pinch hazards when working on or assembling the kiln.
8. Be sure to properly tension the springs on kilns equipped with lid lifters.

9. As with all electrical products there is danger of electrical shock. Use only properly sized and rated copper wire when installing the power supply for your kiln. Ensure all electrical work is done by a qualified licensed electrician.
10. The elements inside the kiln chamber will cause an electrical shock if touched. Never insert metal instruments or place any part of your body into the kiln while it is firing.
11. Only use manufacturer supplied plugs, do not use an extension cord.
12. Disconnect power when plugging and unplugging the kiln.
13. Secure the power cord to prevent movement and ensure it does not touch the kiln's case as it could melt and start a fire.
14. Ensure the cord is in good condition and does not overheat. During the firing process, check the temperature of the main power cord at the receptacle. If it is hotter than normal, check for corrosion or loose connections. If any abnormalities are present, disconnect the kiln and replace the plug.

Fire Safety

Kilns should be equipped with a limit timer (manual controlled kiln), or thermocouples (automatically controlled kiln) which are safety devices that turn off the kiln in an emergency. No device is full proof and as such a kiln should not be left unattended when firing. The proper placement of thermocouples is crucial to the proper operation of all automatically controlled kilns.

Additional safety measures

1. Install a thermometer in the room to monitor temperature.
2. Monitor the kiln and ensure it does not exceed the rated temperature as specified on the serial plate.
3. Do not store combustible materials near the kiln.
4. Check all thermocouples for damage and correct placement.
5. Ensure a fire extinguisher rated for electrical fires is accessible near the kiln.
6. If a kiln must be fired overnight, ensure there is training for staff monitoring the kiln during off hours.
7. If there are fire sprinklers located in the kiln room, ensure they are rated high enough to prevent them from setting off when the kiln is at peak temperature. Consult with a licensed fire protection contractor to obtain the correct sprinkler head design and installation prior to using the kiln. Ideally a fire alarm may be optimal as it can alert personnel if the room temperature rises above acceptable levels.

Maintenance

1. Kilns should be regularly maintained.
    a. This includes regular inspection, particularly where sockets and flexible cables are used.
    b. Kilns should be periodically tested to ensure that the bonding, insulation connections, and electrical protection are operational.
    c. If faults are found, the kiln should be taken out of service until the faults are repaired.
2. After each firing, inspect the kiln to ensure there are no abnormalities. i.e.bulging out of grooves, cracks, or glaze on the walls.
3. Any work carried out on the kiln should be done by a trained professional who is familiar with the type of equipment.

4. School or district kiln operators should maintain up-to-date records of the nature and extent of all maintenance and repair work carried out on the kiln(s).
5. Always unplug the kiln before performing any repairs or general maintenance. If your kiln is wired direct, turn off the breaker.
6. Use only OEM replacement parts. Improperly sourced parts may pose a hazard and may void the warranty.
7. Never modify the kiln without first consulting the manufacturer. Improper modifications may pose a hazard. Items such as alternative thermocouples, controllers, and kiln coatings may ruin the kiln if improperly installed or applied
8. Maintain and replace any electrical components that are discolored, brittle, or corroded.
9. Replace kiln parts that are worn or as stated in manufacturer's guidelines.
10. The controller is a temperature control device, not a safety device. Follow all manufacturer instructions. The controller may contain static-sensitive parts that may be damaged by static electricity. Use caution to avoid creating static that may damage the equipment. In areas where static electricity is common, or during dry times of the year throughout the country, touch the kiln lid handle before touching the controller to discharge the static.

Operation of the Kiln

Staff that operate a kiln should be trained on a regular basis to ensure their safety and the safety of their students. Public Schools Works offers a general kiln safety course, or you may reach out to the manufacturer of the kiln in use to see if they offer training for your model.

Additional safety measures

1. Ensure the staff is familiar with the kiln and knows the safety controls and devices.
2. Ensure the staff knows when to recognize danger and how to handle an emergency.
3. Ensure the staff follows safe operating procedures, including loading and unloading a kiln.
4. Ensure the ventilation system is operating before, during and after firing to prevent inhalation of kiln emissions.
5. The actual starting of the kiln and all actions associated with the kiln while it is in operation include the actual opening of the kiln upon completion.
6. Be careful when opening the kiln door while the kiln is heated. Use fire rated gloves to protect your skin and make sure long hair and clothing is kept well away from any kiln opening or hot kiln surface.
7. High school students may operate the kiln after training and under the direct supervision of instructor. All training of students must be documented.
8. All students may participate in the loading and unloading of the kiln with instructor supervision and proper training.
9. Students may construct, operate, load and unload simple kilns where learning outcomes pertaining to kiln operation are relevant to a particular course of study. In this activity, students must always be under the direct supervision of a teacher.
10. The kiln should not be unloaded after firing until the outside of the kiln and the pieces inside are cooled. This is approximately 125 degrees or lower, refer to the manufacturer guidelines for more specific information.
11. Consider a checklist for Kiln Operation. Examples below are what may be included.
    - ☐ Is the operator of Kiln trained?
    - ☐ Are operating rules and instructions posted near the kiln(s)?

- ☐ Is the ventilation working adequately in the kiln enclosure?
- ☐ Do you have the appropriate personal protective equipment?
  - ☐ Thermal gloves
  - ☐ Apron
  - ☐ Eye and face protection
- ☐ Do you fire the kiln approved hours of operations?
- ☐ After firing, do you leave the extraction fan on, open the kiln door and allow the gas emissions to disperse before unloading?
- ☐ Is the kiln area free from obstructions and able to be easily accessed?
- ☐ Is the kiln enclosure area cleaned using the prescribed methods?
- ☐ Are personal hygiene procedures followed after the use of the kiln?
- ☐ Is the kiln inspected at regular intervals and maintained in good order?

Additional Safety Measures

1. All ceramic materials should be supplied with a Safety Data Sheet (SDS).
2. Kerosene, oil drip, wood-fired or sawdust kilns must not be used in schools.
3. The kiln site should be well illuminated.
4. Food or drink is not to be taken into the kiln/ceramic work areas.
5. Have a plan in place for a staff member to be present when the kiln is scheduled to turn off.
6. Long term viewing inside the kiln chamber can cause eye damage. Therefore, it is recommended that you use IR and UV protective glasses when looking into the kiln for extended periods of time. Glasses shade rating should be between 1.7 and 3.0 to protect your eyes. Regular sunglasses don't provide enough protection.
7. Be cautious of intense heat around the peep holes when peep plugs are removed.
8. In the event of a severe storm, unplug your kiln. Exposure to static shock or electrical surges can damage the circuit board in the controller.
9. Kiln lids on many models are heavy. Make sure the lid brace is secure before releasing the lid and the brace is not corroded.
10. Do not place anything in the kiln about which you are unsure. Certain items may potentially melt, explode, or release toxic fumes. Items that may be damp (i.e., greenware, kiln shelves) have the potential to crack or explode inside the kiln when the moisture trapped inside them turns to vapor when heated.