TECHNOLOGY ASSESSMENT PROGRAM (TAP)
Glovebox Fiberglass Reinforced Plywood (FRP) Crates
Technology Assessment Summary

Porter-Cable (743K) Circular Saw with Vacuum System (Innovative Technology)

DEMONSTRATION OBJECTIVE

LANL technicians and IT Corporation demonstrated the Porter-Cable (743K) circular saw with vacuum system at HCET during the Glovebox FRP Crate Size Reduction Assessment on August 13-16, 2001. The purpose of the demonstration was to evaluate performance of the Porter-Cable circular saw with respect to its ability to segment FRP crates following the HCET Test Plan especially designed for this purpose.

TECHNOLOGY DESCRIPTION

Figure 1. Porter-Cable circular saw (743K) with vacuum system.

Figure 2. Porter-Cable circular saw during demonstration.

Figure 3. Crate segments after assessment.

Figure 4. Porter-Cable circular saw used blades.

The Porter-Cable circular saw is a double-insulated circular saw with a power tool-triggered wet/dry vacuum for vacuuming sawdust generated during cutting (Figure 1). Technical specs are 120-v; 15 A; 5800 revolutions per minute (RPM), and double insulation for heavy duty operation. The Porter-Cable saw has a telescoping guard as a safety device for worker protection. The telescoping guard rotates freely and returns quickly and completely to its closed position when not in use. This saw is capable of performing normal cuts, bevel cuts, back cuts, and pocket cuts (plunge cutting). The Porter-Cable circular saw is relatively lightweight at 10.25 lbs. Its dimensions are 1' 2" L x 10" W x 9" H.

The Porter-Cable saw has a vacuum cleaner adapter system to collect sawdust during cutting activities. The vacuum is a power tool-triggered wet/dry system, which operates on single-phase 60 Hz at 120-v. The Porter-Cable vacuum has a power outlet that allows the Porter-Cable saw to be connected. The vacuum cleaner will automatically switch on when the saw starts, and it will automatically switch off approximately 6 to 10 seconds after the saw is turned off.

Porter-Cable Circular Saw Blade Description

The following blade types were used during the glovebox FRP crate size reduction:

- Riptide blade 7¼", 184 mm, 18 tooth – carbide tipped
- Titanium blade 7¼", 24 teeth, 3X sharper; 7900 maximum RPM; model 73-374

RESULTS

One Porter-Cable circular saw was damaged while testing it: The tool was over-forced, and the motor burned out. A second saw was purchased, and testing was resumed. The tool was operated at its own pace without problems.

The technology successfully and efficiently demonstrated its ability to perform horizontal and vertical cuts on the assigned glovebox FRP crate. LANL technicians found this tool very light and fast during cutting activities. Even though the saw has a vacuum cleaner hose as an attachment, LANL technicians worked with it very smoothly. The Porter-Cable vacuum system was able to collect up to 87% of the sawdust generated during the demonstration. It efficiently size-reduced the FRP crate including nails and a 1/16" stainless steel metal piece inserted in the crate. However, the saw could not cut through the stainless steel plate. Sawdust was generated during cutting activities (secondary waste). It is recommended that operators spend 30 to 60 minutes practicing with the tool prior to initiating crate size reduction to maximize tool performance.

The riptide and titanium saw blades cut smoothly and rapidly through the fiberglass, plywood, and nails. Both blades performed similarly, and no advantages were observed from one to the other. Moreover, neither was able to cut

through the stainless steel plate. Some sparks were observed when the blade hit the metal plate, and tool kickback was observed. Figure 2 shows the Porter-Cable saw during operation, while Figure 3 shows the FRP crate after the demonstration. Figure 4 displays used circular saw blades after demonstration.

The technology has a number of advantages: (1) The Porter-Cable circular saw was effective in completely size-reducing one glovebox FRP crate assigned. (2) The Porter-Cable circular saw is very light and easy to use. LANL technicians stated that this tool is easier than the MILWAUKEE, even though they have to deal with the vacuum hose as an additional attachment. The saw can be used to perform different types of cuts with no difficulties. The Porter-Cable circular saw cut through nails with no problem. However, it could not cut through the stainless steel metal plate. (3) The vacuum system was able to capture up to 87% of the dust generated during cutting activities, which minimizes worker exposure to airborne. (4) Production rate and cutting rate were slightly lower than the MILWAUKEE circular saw but still considered high. The additional vacuum hose that a tool operator needs to carry while cutting may affect production and cutting rates. However, LANL technicians found this saw better and easier to use than the MILWAUKEE circular saw. The reciprocating saw was used to finish some small cuts in difficult areas on the crate where the Porter-Cable circular saw could not reach. (5) It is mobile and easy to operate, and set-up and blade replacement are relatively simple. (6) The Porter-Cable circular saw is relatively inexpensive by itself. The vacuum cleaner accessory will increase costs significantly. However, the vacuum cleaner system captures most of the sawdust generated during cutting. (7) Secondary waste generation is mainly fiberglass, wood sawdust, one vacuum bag, and worn-out or damaged blades. (8) Cutting activities can be conducted under safe conditions for operators, evaluators, and the environment. LANL did not experience significant heat transfer while conducting cutting activities.

Some potential disadvantages follow: (1) The Porter-Cable vacuum saw inhibits the mobility of the operator when cutting. This tool requires two operators to maneuver it. One is actually operating the saw, and the second one is holding and directing the vacuum hose to minimize interferences during cutting. (2) The Porter-Cable circular saw is a powerful tool for crate opening but needs a reciprocating saw to finish some difficult areas. (3) A drawn cutting line is needed to facilitate straight cuts. (4) The Porter-Cable circular saw produced noise up to 105 decibels (dBA), which represents a potential noise hazard for operators. (5) Vibration levels for the Porter-Cable circular saw were measured in terms of velocity at the rear handle, and they were >0.200 in/sec. Vibration level was above 0.709 in/sec, which is considered a dangerous level. This level of vibration represents a Hand/Arm Vibration Syndrome (HAVS) hazard for workers who use this tool on a regular basis (8 hrs/day). (6) Secondary waste generation was sawdust, up to 87% of which was collected in the vacuum system.

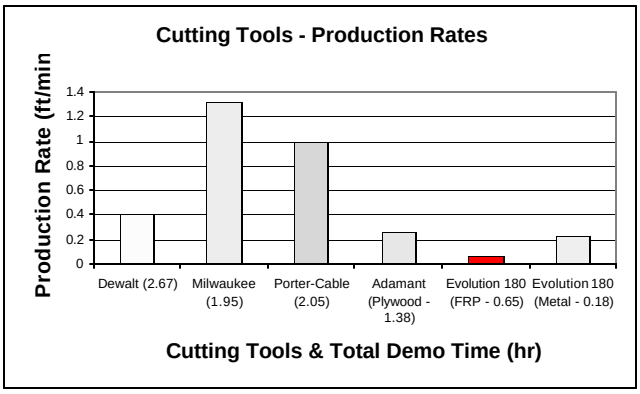
Table 1 summarizes technical data collected during the Porter-Cable circular saw demonstration.

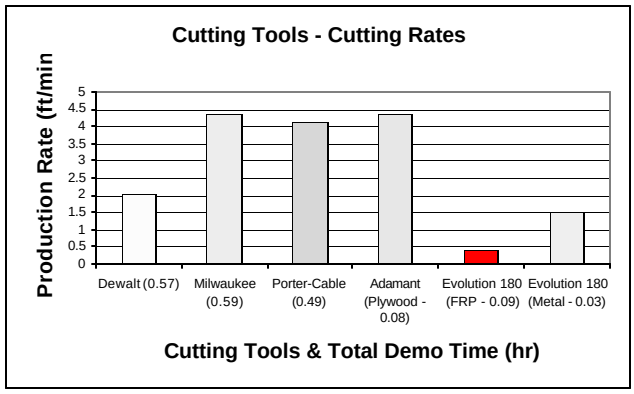
Table 1.
Significant data collected during Porter-Cable circular saw demonstration

Aspect	Results	Comments
Pre-demonstration activities	1hr. and 35 min.	Safety orientation and formal briefing of EMS HCET policy for IT Corporation, LANL technicians, and IUOE representatives. Officials get familiar with the testing conditions under which the demonstration will proceed.
Production Rate	0.99 ft/min	Production rate reflects production time beginning immediately following equipment mobilization and ending at size reduction completion, just prior to equipment demobilization.
Cutting Rate	4.14 ft/min	Cutting rate includes data collection on the time the equipment is in operation. Cutting capability evaluates the ability of each technology to cut crates in different directions and the ability of each technology to dismantle crates to specification.
Total Demo Time	2 hrs. and 3 min	Gross time including production and cutting time.
Total Cutting Time	29.36 min	Only includes cutting time.
Length Cut	HC = 72 ft CTC = 24 ft VC = 26 ft Total = 122 ft	HC: Horizontal cuts; CTC: Crate top cuts; VC: Vertical cuts.
Surrogate Type	Glovebox FRP Crate	Glovebox FRP crate dimensions are 4' H x 8' L x 4' W. A carbon steel pipe, 1/16" thick and 2" diameter, was placed on the front-internal side of the crate to observe tool kick-off performance. The plywood crate was reinforced with four (4) layers of fiberglass and resin up to ¼" thick. The plywood thickness is 5/8" for a total thickness of 7/8". Crate corners and midsections have a reinforced wood frame of 2" x 2".
Blades Used	1 Riptide blade 1 Titanium blade	Includes overall blades used during demonstration.

Aspect	Results	Comments
Waste Generated	Crate Segments of 2' x 2.5'. Sawdust in Vacuum Bag: 6.6 lbs. Sawdust on Floor: 1.1 lb.	Primary waste includes FRP segments, and secondary waste includes sawdust and used blades.
Airborne Particulate Sampling: Air samples collected presented a unimodal distribution. An average weight of 1.111 mg of respirable particulate (9.9 ?m to <0.051 ?m) was collected over a period of 12 minutes for the glovebox FRP crate size reduction assessment. It was found that the sample included overflow due to the large quantities of airborne generated during the Dewalt reciprocating saw demonstration. Respirable particulate is the fraction of the particle mass that may possibly be deposited in the different compartments of the respiratory tract. However, the harmful effects from the inhalation of particles are determined by the toxicity of the material (type of contaminant), air concentration, and particle size distribution.		

Figure 5 graphically shows production and cutting rate comparison for five cutting tools demonstrated during this overall tool assessment.





NOTE: Dewalt, Milwaukee, Porter-Cable, and Evolution 180 circular saws were tested on glovebox FREP crates. Adamant saw was tested on a plywood crate, and the Evolution 180 was also tested in metal.

Figure 5. Comparison of production and cutting rates for all cutting tools evaluated during the assessment.

HEALTH AND SAFETY FACTORS

The noise level generated during the Porter-Cable circular saw operation was above the OSHA action limit of 85 dBA (105 dBA). This represents a potential noise hazard for operators. Vibration level was measured at the rear handle in terms of velocity. Vibration frequency range is 10 Hz to 1 kHz; to a maximum of 2 in/sec. Vibration level for the Porter-Cable circular saw was >0.200 in/sec. Vibration levels above 0.709 in/sec are rated as dangerous per Computational System Incorporated (CSI) Graph provided with a hand-held vibration meter used for this purpose. This level of vibration represents a HAVS risk for workers who use this tool on a regular basis (8 hrs/day).

SUMMARY AND RECOMMENDATIONS

(1) The Porter-Cable circular saw is a very light tool and easy to use. This tool needs an auxiliary (reciprocating) saw to complete cutting some difficult areas where the Porter-Cable cannot reach. The saw is fast and appropriate for this type of job. (2) The selection of appropriate saw blades is critical for the performance of the saw. It is recommended always to use sharp blades. Dull blades tend to overload the tool and increase the chance of tool kickback. (3) Never force the tool. Forcing a saw reduces control and cutting efficiency and may cause motor burnout. (4) It is recommended that a drawn cutting line be followed by operators while performing cutting activities. This also will help them control the tool better. (5) Workers must use ear protection to mitigate noise levels generated during cutting activities. Since vibration levels were classified as dangerous, workers should be protected. Vibration hazard mitigation can be done by providing workers with anti-vibration gloves. Anti-vibration gloves are made of a visco-elastic material and/or Gelfom, which is available in numerous formulations and brands.

For additional information about this glovebox FRP crate size reduction technology assessment, contact Carmen Alicia Aponte, Project Manager, Technology Assessment Program, HCET, (305) 348-6556, email: caponte@hcet.fiu.edu.