



APPLE PUREE PROCESSING LINE

Industry Building Capacity Program
Final Report

Noggins Corner Farm II Ltd.

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Executive Summary

This infrastructural project supported establishment of the first in Nova Scotia Apple Puree processing facility. It provided matching funds, complementary to major private investments of Noggins Corner Farm towards renovation of production area and setting GFSI certified fruit processing facility.

The project resulted in the development of Apple Puree processing line and auxiliary equipment (bottle wash machine, oven for bottle pasteurization), as well as critical modification of existing building with respect to CFIA requirements. Apple Puree line is complementary to existing drying facility, offering a new range of marketable products from apple puree to natural fruit leather. Apple puree has exceptionally high nutritional and antioxidant value, as well as attractive appearance of fruit puree compared to similar products available on the market. With a long shelf life it could be used as a separate commodity or as ingredient to produce a variety of premium quality natural fruit products. This project is the logical continuation of a previous projects funded by NSDA towards research and development of novel technology and innovative food products, which will enhance the domestic and international competitiveness of the overall sector.

The project was developed in partnership with the group of highly motivated apple fruit growers: Stirling Fruit Farms, Hennigar Farms, Indian Garden Farms and Ridgeview Farms. This project is of strategic importance for apple growers, because apple puree line is able to provide additional revenue stream up to \$1,000,000 based on annual volume of low-value apples. Project supported industry in such developmental capacities: (i) full utilization of harvested fruit up to 99% (instead of 40-60%), (ii) diversification of market for value-added products; (iii) increasing of farm/cooperative profitability. It also addresses barriers to development of apple industry, providing unique opportunity to extend the shelf-stability of fresh produce. Development of local apple puree processing capacity satisfied consumer demand on local, healthier, nutritious and of premium quality foods. Also, natural fruit purees are important ingredient for the food industry in a variety of bakery products like bread, muffin, cookies, cakes & other products like cereals, ice cream and yogurt. In addition to the benefits for the food industry, nutritious and high quality fruit puree products contribute to the improvement of the health and wellness of Canadians.

Background Information

Noggins Corner Farm is one of the most successful businesses in Atlantic Canada, producing about 52 varieties of apples, pears, cherries, peaches, plums, and raspberries from 250 acres of land in Annapolis Valley. Over the years, the company has expanded operations to advanced cold storage and modern market facilities to serve local customers. Although the market for fresh fruits is constantly growing, shelf stability of fresh produce is the major limitation for further business expansion.

Through innovation and continuous reinvestment, the company has experienced continued growth over the years. Specifically, during the past 7 years, the company has invested over \$4.5 million in capital assets ranging from tractors and related equipment to our state of the art storage, market and packing facility completed in 2016. It has been identified that apple puree processing line will bring a solution for full utilization of harvested apples increasing the return per bin from \$45 to \$425. Moreover, further drying of apple puree into fruit leather will increase return per bin to \$600. With family business growing, Noggins Corner Farm is well positioned for the successful implementation of this project.

Project Objectives and Value Proposition

The objectives of this project:

- 1) To develop technological capacity to produce convenient natural foods that meet the increasing customer demand (all natural fruit puree, spread or fruit snacks)
- 2) To increase market opportunities and profitability of local fruit growers (our and our partners farming operations)

It is expected that market demand for natural foods, produced from local fruits and berries, will allow fruit growers to gain a competitive edge on the market place. The long-term objective is the development of new technological platform, which will enhance technological capacity of local fruit growers and create new opportunities for local value-added processing. In this way the project will make a real impact on rural communities by boosting local food manufacturing. We anticipate the focus towards local food manufacturing will facilitate development of new policies, education and sustainability of rural communities.

Apple puree with long shelf stability will have universal value for the development of other “all natural” fruit-based convenience foods. Accomplishing this project will support industry in such developmental capacities:

- i) Better utilization of apples up to 99% instead of 40-60% (Figure 2).
- ii) Diversification of market for value-added products
- iii) Increasing cooperative/farm profitability.

Apple puree processing line made available full utilization of harvested fresh apples a new business model presented in Figure 1.

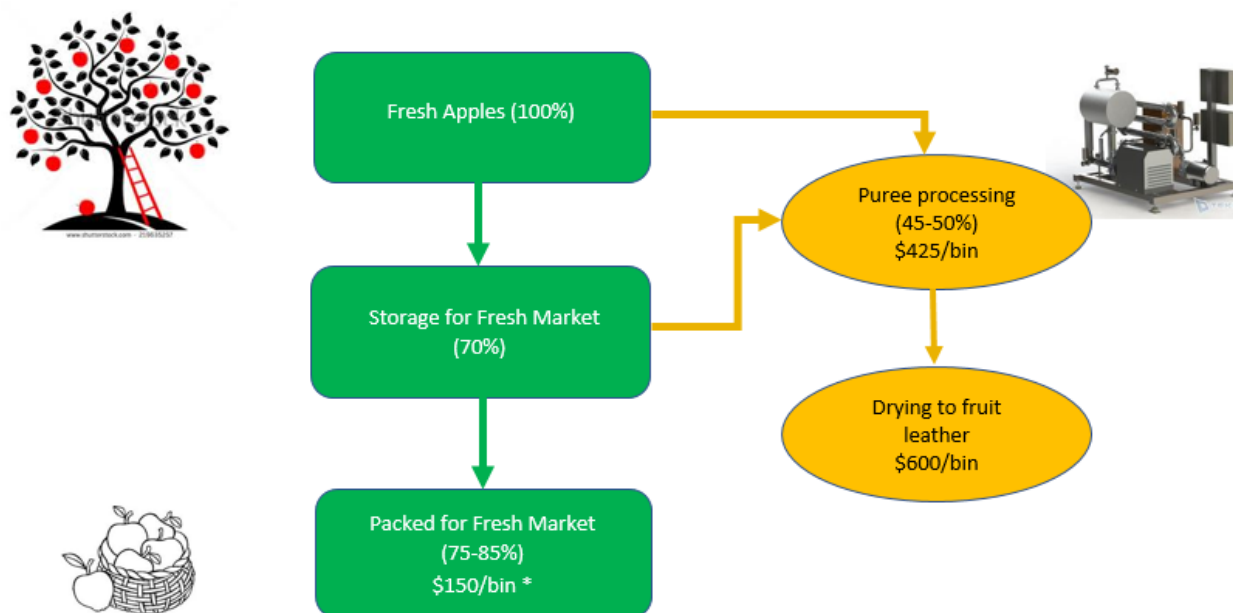


Figure 1. Proposed solution for full utilization of harvested fresh apples

Project Implementation

Based on his existing partnerships with apple industry, the NSF owner Andrew Bishop was primarily responsible for project management and regular communications with industry partners. He took major responsibility for the major renovation of current drying facility for food grade processing, including installation of new wall panels, floor renovation, plumbing and electrical work. Renovation with respect to food-grade HACCP standards was provided in close collaboration with CFIA authorities. Installation and commissioning of specialized equipment and specialized engineering services was provided by local engineering company.

The project was implemented from May 2017 – February 2018. This frame does not include pre-project activities (January-March 2017): preliminary conversation with potential stakeholders, identification of project partners in apple industry, developing business plan and securing support. Securing funding from Nova Scotia Department of Agriculture allowed NSF to start hiring engineering company for the preliminary inspection of production facility: choosing locations for equipment installation, power and water supply. Design of equipment and communications on the floor plan is presented in Appendix 1.

The major part of the project was scheduled for summer 2017. Preliminary engineering work on specification for standard and specialized equipment, quoting and ordering specialized equipment was done by June 2017 (Task 3). Accomplishing of this project required specialized equipment, which was custom designed and manufactured by Tekmash (model SM-SS-30), progressive cavity pump (Soltec, USA) and fruit grinder (Elnova, Canada). These major pieces of equipment presented in Figure 2.



Figure 2. Specialized equipment for apple puree processing line: Apple puree processor (a), progressive cavity pump for loading equipment (b) and grinder (c).

At the same time the renovation of existing drying facility with installation of food-grade wall panels, floor renovation, drainage system, sewer line design, plumbing and electrical work was accomplished (Task 4): Renovation was done with respect to food safety standard in preparation for the next GFSI certification as a food grade facility. By July 2017 specialized equipment was in place and engineering company started integration of standard and specialized equipment for puree processing line. Welding of stainless steel pipes, connections, and electric conduits. All equipment with installed hardware and software was pre-assembled before harvest season in July 2017 (Task 5). Commissioning equipment according to the specification and projected capacity was done in August 2017. This timeline gave us a chance to do training of the dedicated personnel. The operation, maintenance and technical service of this equipment required trained personnel. Ms. Dandan Wang, former MSc student from Dal-AC with previous experience in this novel technology, has been trained in operation of commercial-scale apple puree processing equipment (Figure 3).



Figure 3. Training of Ms Dandan Wang in operation of puree processing machine.

Task 7 was development of standard operational protocols (SOPs) for equipment maintenance, sanitation, cleaning in place, apple preparation and puree processing. From August to November 2017 she developed a set of standard operational protocols (SOPs) for equipment maintenance, sanitation, cleaning in place, apple preparation, puree processing (see sample in Appendix 2). By March 2018 she has prepared all documentation and operational protocols required for HACCP food safety audit and certification of facility and apple puree processing line by third-party auditors.

In the process of industrial testing of puree processing line, the range of puree products and juices was developed:



Figure 4. From left to right: Peach puree, strawberry puree, apricot puree, nectarine puree, orange puree, cauliflower puree, apple puree, apple juice and pear juice



Figure 5. Samples of natural tomato sauce paste is presented in Figure 5.



Figure 6. Hot fill bottling line of product after pasteurization

Also, the technology for commercial production of natural fruit leather was developed. It included a special stainless steel pans (Figure 7(a)). A commercial sample of natural fruit leather is shown in Figure 7(b).

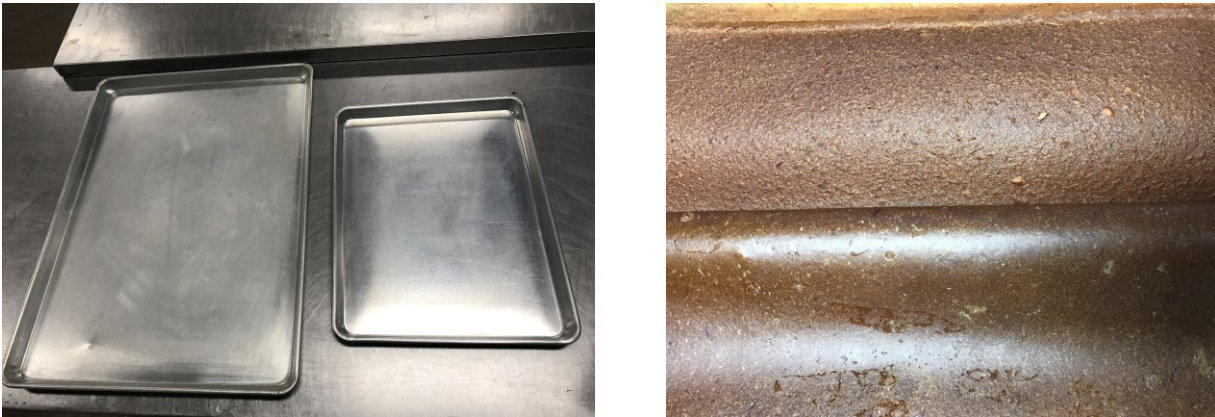


Figure 7. Technology for production of natural fruit leather

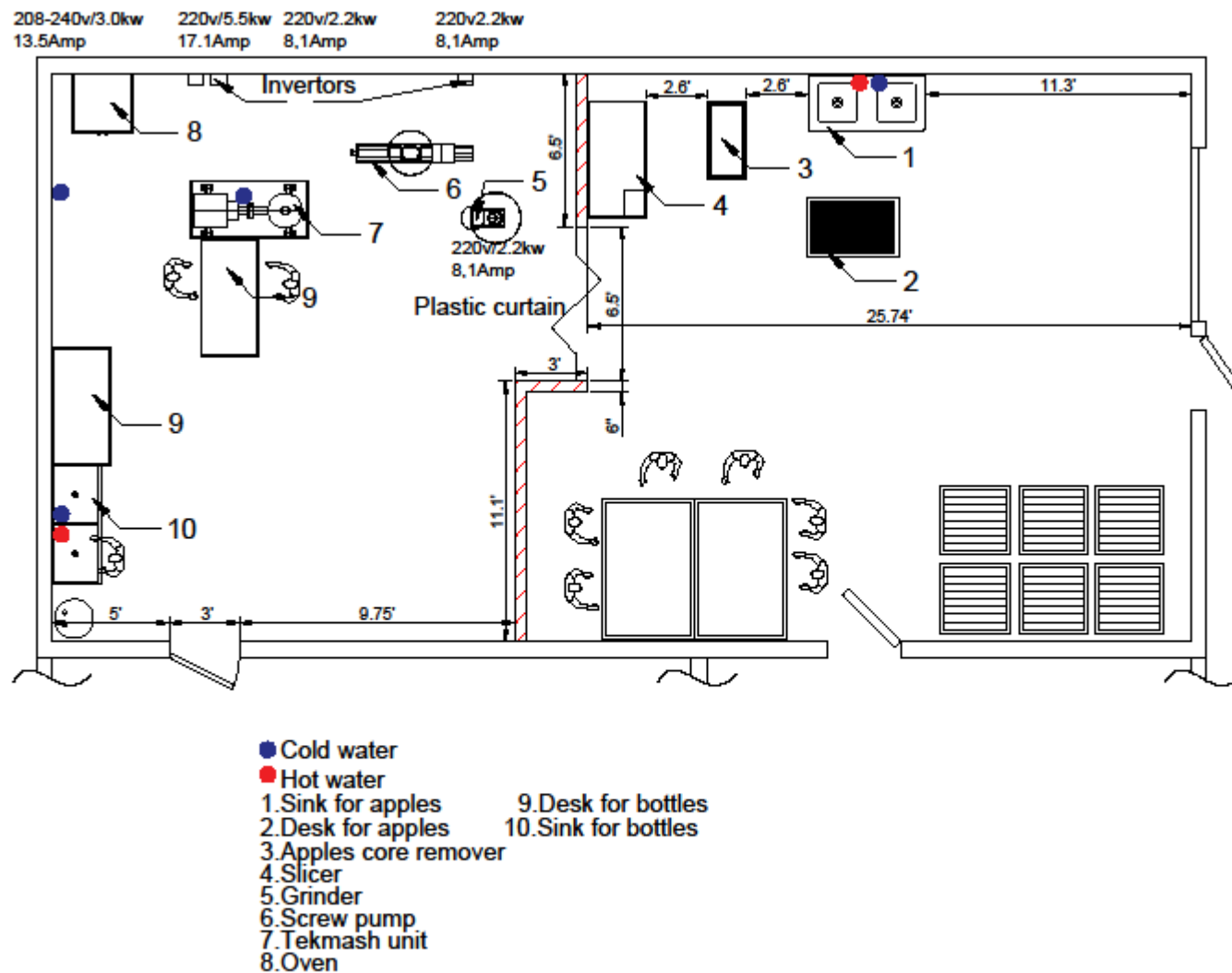
All stages of the project, including installation, commissioning and testing of specialized equipment were accomplished in full agreement with previously developed evaluation plan with respect to initially established timelines and budget.

Acknowledgment:

We highly acknowledge financial support of Nova Scotia Department of Agriculture through the program “Building Industry Capacity”, which made possible full scale development of this infrastructural project. We also thankful to research team from Dalhousie University, Faculty of Agriculture, who developed technology, trained qualified personnel and supported us on all stages of project implementation.

Appendix 1.

Floor layout design for apple puree processing line



Appendix 1. Floor layout design for apple puree processing line

Appendix 2.

Standard Operational Procedure for Cleaning and Sanitation of Apple Puree Processing Line

SOP 1.01

Total Pages: 12

Date Effective:

Title: Sanitation Work Instruction

Purpose: To avoid contamination of product from ineffective sanitation.

Responsibilities: Primary operatives: All staffs involved with the SOP 1.0. All persons unfamiliar with the sanitation work will read SOP 1.01 and will be required to work under the supervision of an experienced technician until a level of comfort and competency with the procedure is reached.

References:

Material safety data sheets for the chemicals in use

Forms:

Form 2.04 Equipment sanitation record

Form 2.07 Cleaning Procedure checklist (before production run)

Form 2.08 Cleaning Procedure checklist (after production run)

Scope

This instruction is intended to ensure effective sanitation of equipment and facility.

Definitions and Abbreviations

Refer to Glossary of Terms and Abbreviations.

Procedure

Equipment to be clean

1. Room A: Blender
2. Room B: Tekmash unit, bottle washer
3. Premises: Ceiling, walls and floors

Equipment cleaning frequency is after each production run

Equipment and tools required

- Portable Cleaning Station with Two jugs of Chemicals
- Chemicals for CIP (Clean In Place)
- Water Hose(s)
- Fogger
- Pressure Washer

Chemicals and concentration used

1. Swish Food Service Disinfectant/Cleaner.

Disinfection:

Hard Surfaces, industrial floors, walls, food processing equipment, table tops, counters, display racks processing and packing plants and other food processing areas –
Dilute 1:25 parts water (5 oz/gal or 40 mL/L).

Allow solution to wet all surfaces thoroughly and remain wet for 10 minutes. Let air-dry.

Sanitizing:

To sanitize pre-cleaned, rinsed non-porous food contact surfaces –

Dilute 1:80 parts water (200 ppm active quat., 1.6 oz/gal or 13 mL/L). Allow solution to contact surfaces for at least 60 seconds. Let air-dry. Prepare fresh solution for each use.

Note: Increased cleaning efficiency is experienced with increased temperature of solution.

2. Swish Food Service 2000 Sanitizer.

Sanitizing:

To sanitize surfaces previously cleaned with Swish Food Service Disinfectant Cleaner-

Dilute 1:512 (1/4 oz./gal or 2 mL/L). This prepares a 200 ppm quat sanitizing solution of Swish Food Service 2000. Allow to contact surface for at least 60 seconds. Let air-dry. No further rinsing is required.

Test kits required

3. Chlorine test paper
4. pH test paper

Safety equipment

5. Goggles
6. Gloves
7. Hair Net
8. Lab Coat
9. Rain Pants
10. Rain Coats
11. Mask/Respirator
12. Rubber boots

General safety considerations

1. Always wear proper safety protection!
2. Never add water to chemicals. Always add chemical to water. Report all accident immediately!
3. When applying the foam to equipment, caution should be given of slippery floors and surfaces.
4. Slashes from the chemicals and foam should be removed/washed out immediately.
5. Carry chemicals using appropriate handle.

Preparations

- Use appropriate personal protection (goggles, hair net, rubber gloves, heat resistant gloves, and rubber boots).

- Check water supply, prepare water hoses, the pressure washer and portable cleaning station.
- Prepare chemical testing kits and test strips.
- Check concentration of cleaning solutions using testing kits.

Basic cleaning steps

Pre-rinsing

Use cold/warm water for pre-rinsing. Normal pressure hoses or a pressure washer can be used. The purpose of pre-rinsing is removing the major part of apple solids and other residues from the equipment (no visible traces of apples).

Cleaning solution application

Apply cleaning solution on equipment surfaces, walls, floors and any other areas that require cleaning using spray bottle. Surfaces might require manual scrubbing with a brush in case of heavy residue build-up. Use of goggles and rubber gloves is mandatory.

Foaming

The purpose of foaming clean is completely cleaning of surfaces (walls, floors, ceilings, equipment, etc.). The surface should be visible clean as a result of pre-rinsing before foam cleaning. Use portable cleaning station for foaming.

Put safety goggles on and ensure that they are fitting correctly to your face, use appropriate safety equipment. Apply an even layer of foam on all surfaces to be washed.

Rinsing

Use tap water for rinsing. Normal pressure hoses or a pressure washer can be used. The purpose of rinsing is completely removing residues of foams on the equipment surface. Use test strip to control the quality of rinsing (neutral reaction is required) of each piece of equipment.

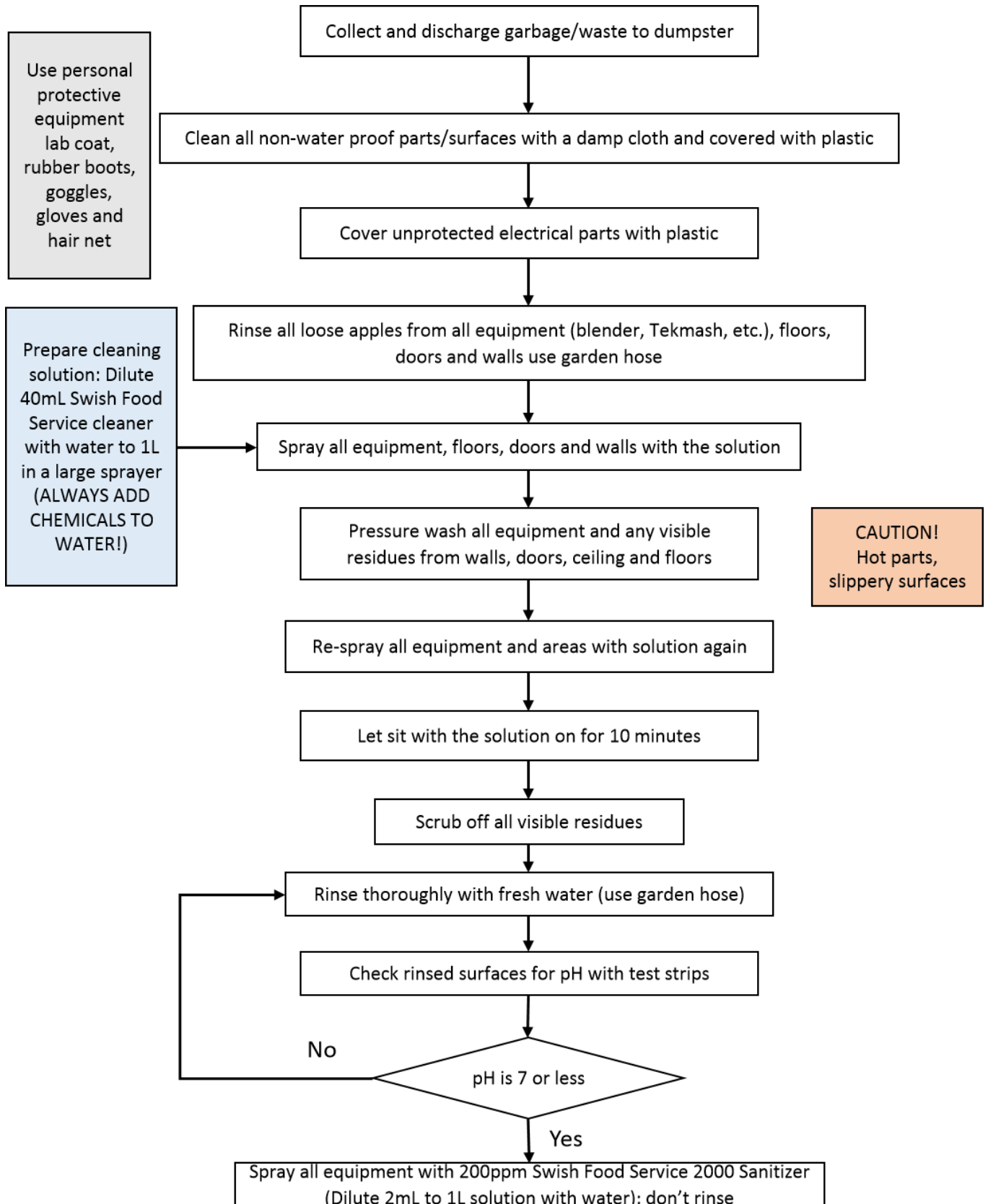
Sanitation

The purpose of sanitation cleaning is providing industrial sterility of equipment surfaces. The surface should be visibly clean and should not have any product or foam residues. As a result of sanitation cleaning, the equipment surface should be wet but no puddles should left on the surfaces. Use plastic/silicon/rubber squeegees to remove extras from the food contact surface.

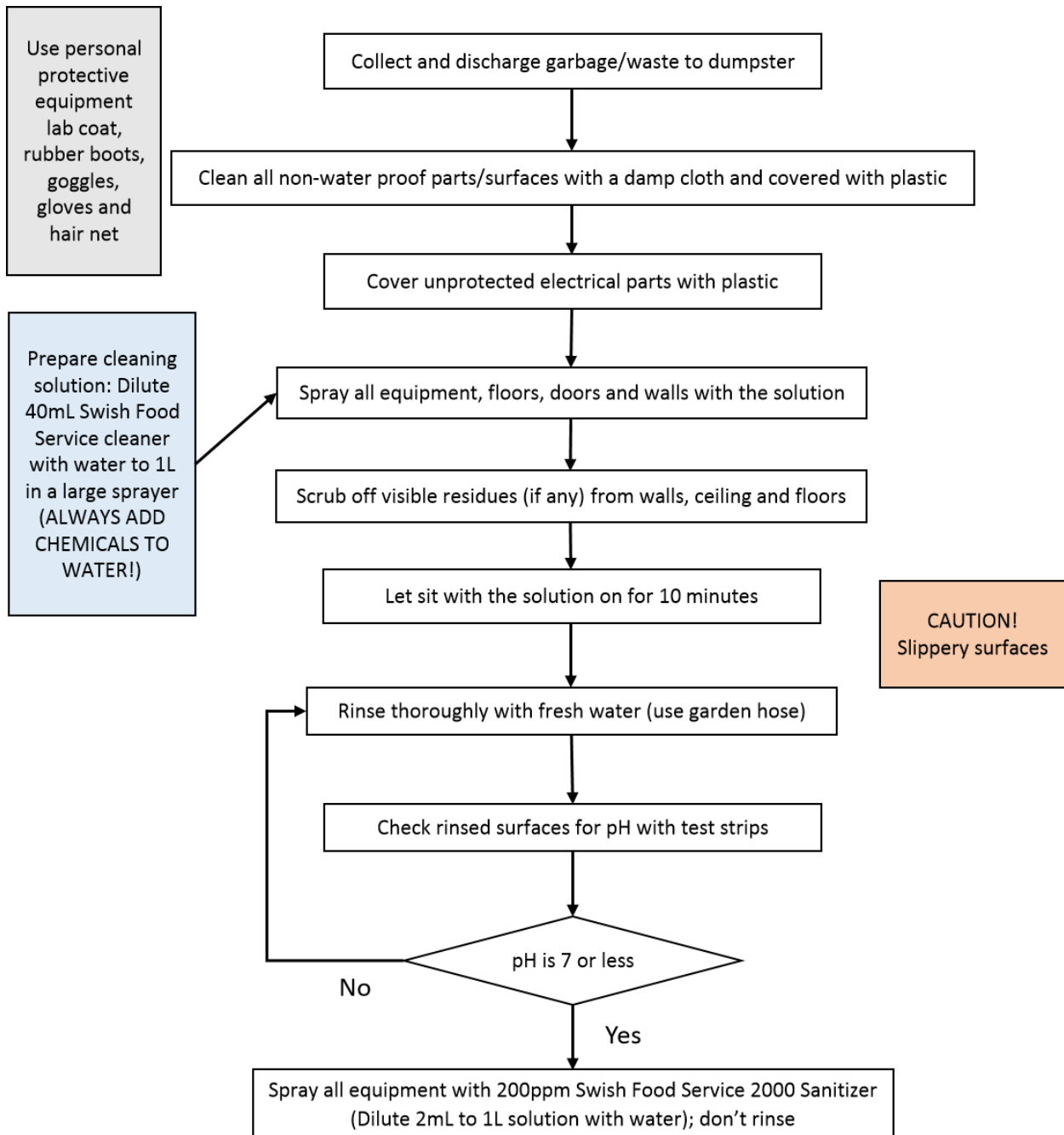
Put safety goggles on and ensure that they are fitting correctly to your face, use appropriate safety equipment

Apply an even layer sanitizer on all surfaces to be cleaned.

After run sanitation is required to remove product residues from equipment and premises and provide sanitary conditions of surfaces after production run



After run leaning and sanitation flow chart



Before run cleaning and sanitation flow chart

Responsibility

Food Safety Team Leader is responsible to implement, revise and maintain this standard operating instruction.

The Sanitation Supervisor/operation Manager is responsible to ensure that the sanitation employee have valid WHIMIS Training and understand and follow safety procedures.

Employees are responsible to follow all safety procedures set out by the supervisor as it specified in the MSDS sheets.

Quality Records

Records are controlled, indexed and stored as outlined in the procedure for Control of Quality Records.

Reference Documents

Documents pertaining to this instruction are controlled as described in the procedure for document Control.

Authorization

Food Safety Team Leader/Management Representative

Form 1.04 Equipment Sanitation Record

Date (mm/dd/yyyy)_____.

Equipment and Premises	Cleaned by: Initial	ATP OK- Y/N	ATP after re-cleaning OK Y/N	NCR	ATP checked by: controller Initials	Comments
Blender						
Tekmash						
Bottle Washer						
Ceiling						
Walls						
Floors						
Other (specify)						

Designated Staff (Print Name)_____Sign_____Date (mm/dd/yy)_____.

Food Safety Team Leader_____Date (mm/dd/yy)_____.

Issued_____.

Form 1.07 Cleaning Procedure Checklist (Before Production Run)

Date (mm/dd/yyyy): _____

Procedure	Performed by (Initials)	NCR	Comments
Room A			
Collect and discharge garbage/waste to dumpster.			
Cover unprotected electrical parts with plastic			
Prepare cleaning solution (1L): add 40mL Swish Food service cleaner to water in a large sprayer (ALWAYS ADD CHEMICALS TO WATER!).			
Spray all equipment (blender), floors, doors and walls with the solution.			
Let sit with the solution on for 10 minutes.			
Scrub off visible residues (usually required for floors and blancher).			
Rinse thoroughly with fresh water (use garden hose).			
Check rinsed surfaces for pH with test strips (should be 7 or less; otherwise perform second round of rinsing).			
Spray all equipment with 200ppm Swish Food service 2000 Sanitizer solution (use chemical mobile station).			
Room B			
Collect and discharge garbage/waste to dumpster.			
Prepare cleaning solution (1L): add 40mL Swish Food service cleaner to water in a large sprayer (ALWAYS ADD CHEMICALS TO WATER!).			

Spray surface and bottom of Tekmash equipment and floors the day after the run.			
Let sit with the solution on for 10 minutes			
Scrub off visible residues (usually required for floors)			
Rinse thoroughly with fresh water (use garden hose).			

Important Note

- Always use appropriate personal protection equipment when working with the chemicals (goggles, gloves, lab coat, respirator/mask, hair net and hair hat)!
- Be aware of slippery surfaces and hot parts during cleaning procedures!
- Always cover electrical panels!

Initials	Print Name	Signature

Form 1.08 Cleaning Procedure Checklist (After Production Run)

Date (mm/dd/yyyy): _____

Procedure	Performed by (Initials)	NCR	Comments
Room A			
Collect and discharge garbage/waste to dumpster.			
Clean all non-water proof parts/surfaces with a damp cloth and covered with plastic			
Cover unprotected electrical parts with plastic			
Rinse all loose apple solids/residues from all equipment (blender), floors, doors and walls.			
Collect and discharge apple solids/residues from the floor (don't chase down to the drain!).			
Prepare cleaning solution (1L): add 40mL Swish Food service cleaner to water in a large sprayer (ALWAYS ADD CHEMICALS TO WATER!).			
Spray all equipment (blender), floors, doors and walls with the solution.			
Pressure wash all equipment and any visible residue from walls, ceiling and floors.			
Re-spray all areas again.			
Let sit with the solution on for 10 minutes.			
Scrub off visible residues (usually required for floors and blancher).			
Rinse thoroughly with fresh water (use garden hose).			

Check rinsed surfaces for pH with test strips (should be 7 or less; otherwise perform second round of rinsing).			
Spray all equipment with 200ppm Swish Food service 2000 Sanitizer solution (use chemical mobile station).			
Room B			
Collect and discharge garbage/waste to dumpster.			
Rinse all loose apple solids/residues from floors, doors, walls and equipment.			
Collect and discharge berries from the floor (don't chase down to the drain!).			
Prepare cleaning solution (1L): add 40mL Swish Food service cleaner to water in a large sprayer (ALWAYS ADD CHEMICALS TO WATER!).			
Spray surface and bottom of Tekmash equipment and floors the day after the run.			
Pressure wash all equipment and any visible residue from walls and floors.			
Re-spray all areas again.			
Let sit with the solution on for 15 minutes.			
Scrub off visible residues (usually required for floors and blancher).			
Rinse thoroughly with fresh water (use garden hose).			
Check rinsed surfaces for pH with test strips (should be 7 or less; otherwise perform second round of rinsing).			
Spray all equipment with 200ppm Swish Food service 2000 Sanitizer solution (use chemical mobile station).			

Important Note

- Always use appropriate personal protection equipment when working with the chemicals (goggles, gloves, lab coat, respirator/mask, hair net and hair hat)!
- Be aware of slippery surfaces and hot parts during cleaning procedures!
- Always cover electrical panels!

Initials	Print Name	Signature

Appendix 2.

Standard Operational Procedure for Apple Puree processing

Noggins Corner Farm II Ltd.

SOP 1.04

Total pages: 4

Date Effective: November 2017

Title: Apple Puree processing line

Purpose: To provide procedures that ensure the correct and safe operation of equipment and to provide a method for puree processing for protocol 1.0.

Responsibilities: Primary operatives: All staffs involved with the SOP 1.0. All persons unfamiliar with the Tekmash line will read SOP 1.04 and will be required to work under the supervision of an experienced technician until a level of comfort and competency with the procedure is reached.

References:

- Material safety data sheets for the chemical in use

Figures



Figure 1.04.1 Apple Puree processing equipment

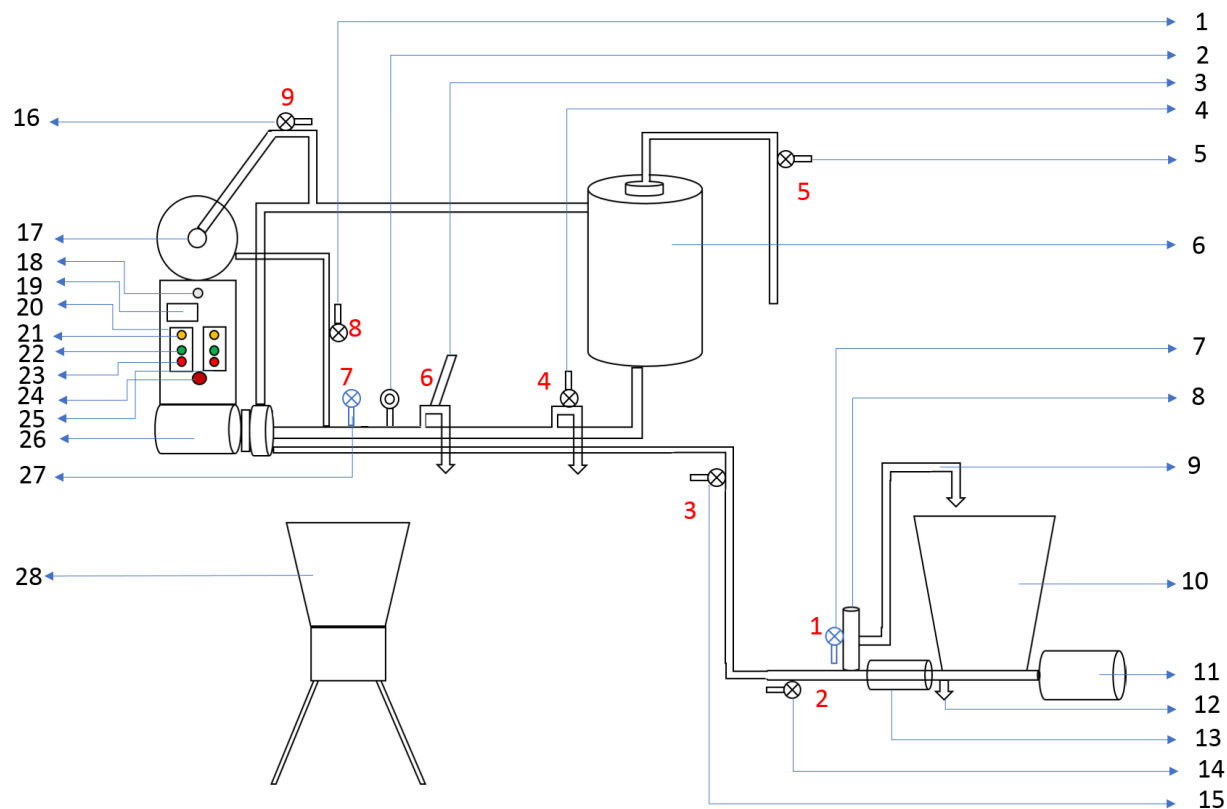


Figure 1.04.2 Schematics of Apple Puree line

1. Valve #8, 2. Pressure meter, 3. Water inlet, 4. Filling valve #4 and filler, 5. Fulfill detection valve #5, 6. Material tank, 7. Pressure valve #1 (keep open all the time), 8. Pressure controller, 9. Filling pipe, 10. Fine grinder tank, 11. Motor, 12. Drain screw, 13. Pump, 14. Valve#2, 15. Valve #3, 16. Valve #9, 17. Motor, 18. Indicator light, 19. Temperature display screen, 20. Control for the Tekmash machine, 21. Indicator light, 22. Switch ON, 23. Switch OFF, 24. Switch STOP, 25. Control for the extra motor, 26. Motor, 27. Valve #8, 28. Blender.

Preparation

4. Equipment should be cleaned and sanitized.
5. Close all the valves except valve #1 (should open all the time).
6. Check correct assembly of unit and examine external surface of unit for presence of mechanical damages.
7. Connect the electricity and water to check water lines for wear and ensure that the connections are tight.
8. Open valves #5 (5), and fill the tank with tap water completely by opening water inlet valve #6 (#3) until water flows down through #5. Close valve #6 (first) and (then) #5.

9. Press START button to run the machine for 1-2 minutes and check for any leakage.
10. When it is done, press STOP button, open valve #5 (#5) to release potential internal pressure.
11. Open valve #4 (4) slightly for water drainage. Open valve #2 (14), #3 (15) and valve #7 (27) for draining as well. Then close valves (#2, 3, 4, 5 and 7) back.

Processing Procedures:

1. Close all the valves except valve #1.
2. Start the blender (28) then fill it with core removed raw materials. The blended raw materials will be collected at the bottom of the blender and poured to the Tekmash machine. Frozen materials should be thawed beforehand.
3. Fill the fine grinder tank (10) with raw materials collected from the blender (28), then turn on the fine grinder. Let the raw materials recirculated until it is ready to be transferred to the Tekmash processing line.
4. Open valve #5, place a basket under it. Then open valve #3 and #7. Fine grinded materials are now ready to be pumped into raw material tank (6). Always check the sample level in the grinder tank, to protect the motor, do NOT empty the tank.
5. When materials flowing out from the pipe (5), turn off the fine grinder and the pump. Close valve #3 and #7.
6. Turn on the switch (22) for the Tekmash machine for 1-2 minutes.
7. For materials that do not require additional water but requires initial crushing in the unit, more material should be added to provide the full load. Press the STOP button to shut off the motor and fill up with more raw material.
8. Then start puree processing.
9. Record temperature changes on the display screen (18) every 5 minutes.
10. Machine will automatically turn off when it reaches target temperature.
11. Push the OFF button (23) to shut down the machine and start filling bottles.
12. Turn on Valve #4 to start bottling, when open valve #5 when there is not a lot of puree coming out.
13. Fill the bottles with puree, tight the caps and put the bottles upside down in the boxes.
14. Next day: primary inspection of bottles, rejecting underfilled and unclean bottles with stain or spilled product and turn the bottles back in the boxes.

Cleaning Procedure:

6. Turn off the valve #4, turn on valve #5 and #6. Let tap water flow into the tank and through the pipes.
7. When water flowing out from the pipe (5), turn the valve #6 and #5 off.
8. Turn on the switch for the Tekmash machine and start cleaning.
9. Let the machine run for 1-2 minutes and turn the machine off.
10. Drain the water by opening valve #4, #2 and #3 (with residual puree) and close back.
11. Fill the machine with water again and repeat steps 1-5, until there is no more puree leftover.
12. Add a small portion of cleaning solution into the tank and repeat the steps 1-5 a few times until no soap residue is observed.
13. Add the sanitizing solution and repeat the steps 1-5.
14. Leave the valve #5 and #4 on to dry the machine.

Maintenance Procedure/Reference

No maintenance is required

Calibration Procedure/Reference

No calibration is required

Monitoring

The food production manager and the Pilot Plant/Building Service Officer ensure that the operator is trained on the use of the Tekmash and they also ensure that the machine is used correctly during production.

Corrective Actions

Any incorrect use of the equipment is documented on the NCF report, the operator may need more training. When the equipment malfunctions it is documented and the Pilot Plant/Building Service Officer is notified.