Implementation of New Nitrogen-Based Anoxic Systems Historic New England, USA

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My name is Adam Osgood, I am the Collections technician and IPM Coordinator at Historic New England. This presentation will serve as an update to a presentation given at the last MPWG presentation event held in 2021.

Historic New England

We serve the public by preserving and presenting New England heritage.

Historic New England is a museum of cultural history that collects and preserves buildings, landscapes, and objects dating from the seventeenth century to the present and uses them to keep history alive and to help people develop a deeper understanding and enjoyment of New England life and appreciation for its preservation.

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In case you are unfamiliar with my organization, Historic
the oldest historic preservation organization in the Unite

Our house museums are in a wide range of the New Eng
have 38 properties and 30 of them are furnished with m
collections with a vary wide range of materials. A full 40
collection is on view or in storage in our historic houses v
varying levels and often minimal climate control.

Because of this we face significant pest challenges seasonally in Clothes moths…

…Carpet Beetles…

…And wood boring furniture beetles

Historic New England has a decades long history of IPM implementing many strategies.

The Old Bubble

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For nearly 30 years, Historic New England has used a thousand cubic foot CO2 based treatment facility effectively for internal use and for outside clients. In 2019 we began seeing signs of wear and inefficiencies in the system and began researching and update and possible replacement to the system.

Discussions with MPWG colleagues Pat Kelley of Insects Limited and Bill Smith of Heritage Packaging led to the conclusion that a conversion to a nitrogen-based system was both achievable and desirable relieving the need to purchase gas, eliminating the use of a greenhouse gas and providing a safer system for personnel among other benefits. It's important to say here that we had an anonymous client off to underwrite the entire expansion and upgrade.

Key Objectives:

-Recreate a 1,000 cubic foot chamber
-Make it airtight enough for continuous flow or possibly static nitrogen efficacious treatment
-A re-usable chamber with a re-sealable door
-Introduce the use of a nitrogen generator

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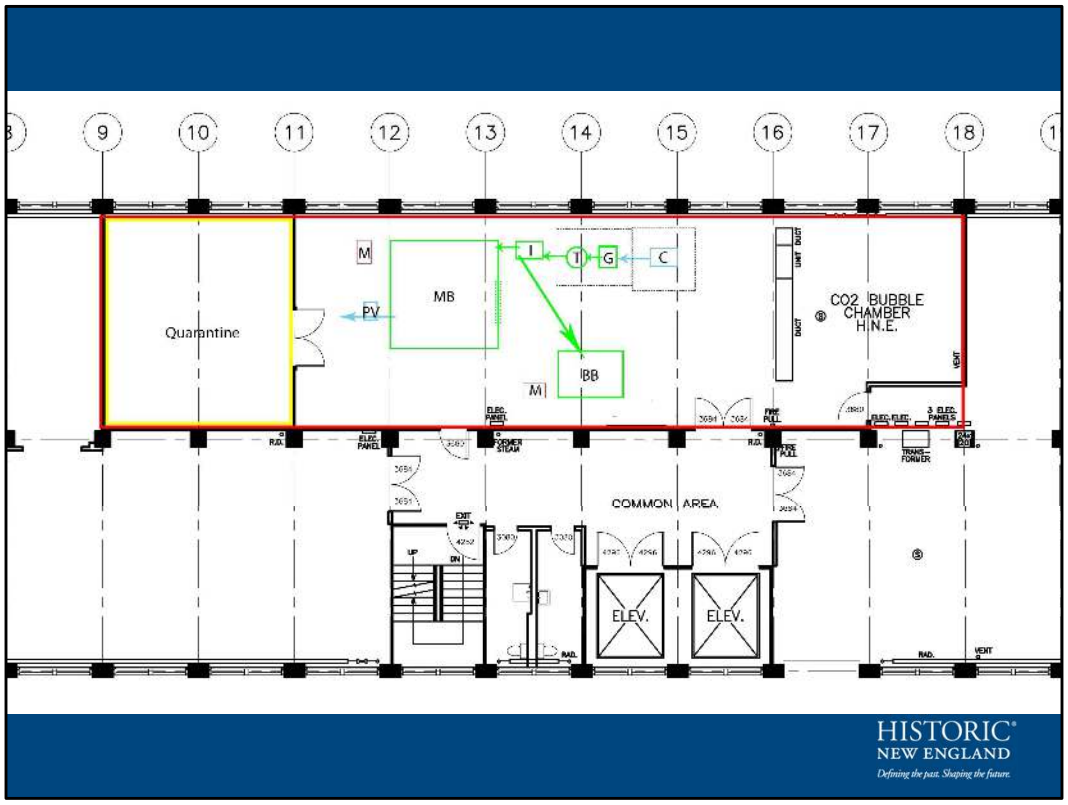
Some of the early objectives in the project were to recreate an chamber of the same size, try to create a system tight enough for a continuos or possibly non-continuous flow system that is re-sealable and using a nitrogen generator to provide an unlimited gas source.

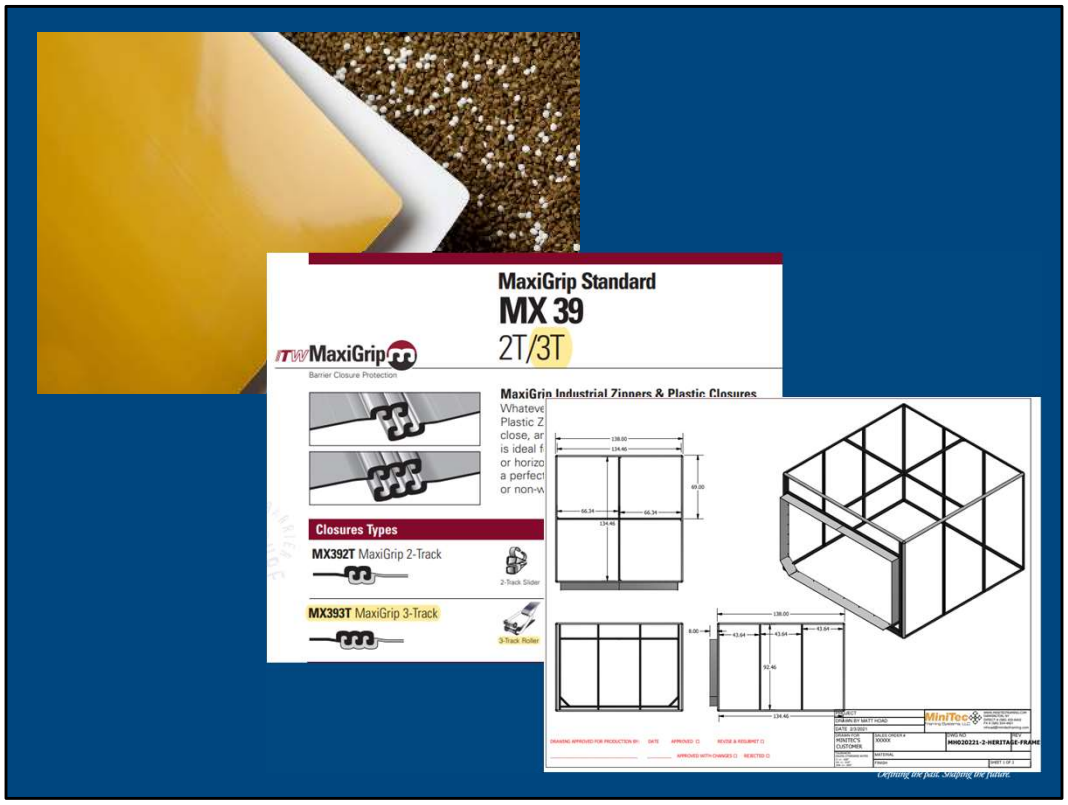
The first physical expansion stage of this project was completed by this time last year. You can see here that we added a sizable quarantine space and also allowed for our CO2 treatments to continue through the course of this work.



You can see here the final floor plan including all the elements.

By last year at this time the air compressor and nitrogen generator had arrived. The compressor on the far right is a rotary screw air compressor made by Kaeser and the nitrogen generator on the left with buffer tank in the middle is a Parker Pressure swing Adsorption (PSA) generator that can reach 99.99% nitrogen purity. Here is a picture of it fully installed with electrical and plumbing.

Over the next couple of months an important aspect of the space upgrade was to improve our supplemental heat system to ensure we can maintain higher temps in the space which is necessary to maximize the efficacy of treatment. The heat is supplemental to our central system which allows us to maintain 80F during treatment. The humidification ensures that we can stabilize and match RH to the conditions inside the chamber so not to shock materials when they exit treatment.



The membrane material VaporBlock® Plus™ 20 is a seven-layer co-extruded barrier made from state-of-the-art polyethylene and EVOH resins VaporBlock® Plus™ 20 is more than 100 times less permeable than typical high-performance polyethylene vapor retarders. And here is an image of the three track zipper design. The membrane is fitted over a custom-made aluminum framework.

Here are some images of the membrane being fabricated by Bill at the Heritage Packaging facility

By May 11th 2021 full installation of the rest of the components was underway beginning with the membrane installation…

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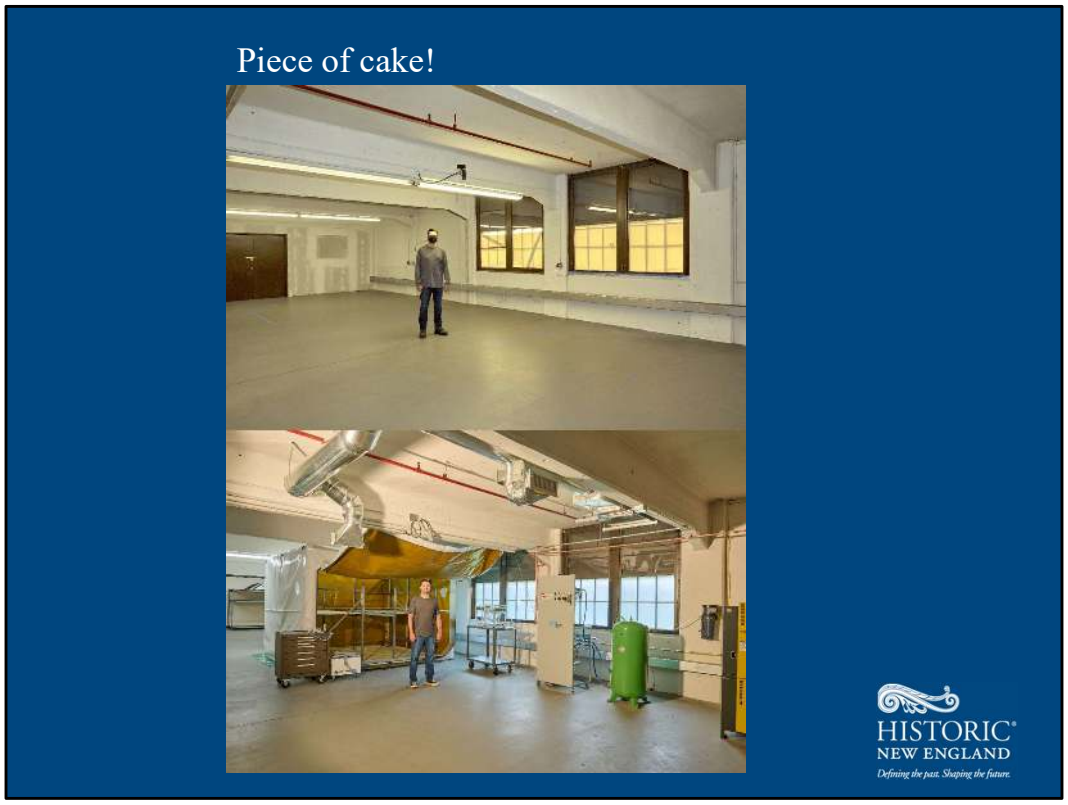
Along with the large or “Mama” bubble, Bill also provided us with a smaller “Baby” bubble which can hold about 175 cubic feet of material and does not have a framework so it can collapse fully. This is an advantage for treating smaller boxed or created material. We can vacuum the membrane tightly around the material and then only need treat the volume of what’s inside rather than the commitment of full volume in Mama bubble.

Pat Kelley and his colleague James Feston also came to personally install the introduction system which included a remote switch allowing us to turn on or off the nitrogen flow from anywhere with a computer or smart phone and a custom-made humidification system to ensure the very dry nitrogen does not shock materials inside upon introduction.

Pat and James also installed the monitoring system for the Mama and baby bubbles. The sensors and software is provided byt the company Rotronic. The monitoring system will allow for Temperature Relative Humidity and O_2 to be monitored in person or remotely using cloud technology.

By the end of the second day, May 12th the whole team pitched in to load the chamber with non-infested, non-collection institutional boxed archives. We had a hiccup with the wrong O2 sensor sent from the vendor, so we pressed on with the test using a red light green light anoxibug O2 sensor and bioassays provided by Pat. By June 2nd the anoxibug light was green and three weeks later we terminated the test and confirmed mortality in the bioassays. We performed various test on the large and small bubble after that while awaiting the proper sensor and in that by the end of July time we had desperate and formidable client wanting to skip our CO2 treatment queue. We offered them a treatment in our new nitrogen system using the anoxibug system and they agreed. This treatment was also performed successfully. Once that treatment was complete we were able to do a test run after finally receiving the proper O2 sensor. In this scenario we started introduction on August 27th and reached .14% O2 by October second. This is the lowest recorded O2 level reached to date.



Since our installation in total, we've run four successful treatments in Mama bubble and are currently running our fifth with clients scheduled to fill the chamber for treatment into July. We have yet to run a full treatment in Baby bubble. In this process we've been looking at what our target number will be for treatment as that number impacts greatly the time needed to start the cycle. This combined with continued testing of introduction techniques we've been able to get our treatment time from introduction start to termination down to under five weeks. At this point most of our objectives have been met with the exception that we have not yet been able to attempt a static treatment

We are continuing to run tests and treatments and refining our procedures and policies with a goal to have the system running optimally by the fall of this year.