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Videotape Cleaning

No specific standards exist for the cleaning of videotape. There are, however, specific and limited instances when videotape is cleaned, yet it is not a normal process to which a tape should be consistently subjected. The exceptions are when the tapes are going through binder hydrolysis or when the tape simply has too many foreign particles clinging to its' surface. There are several different processes by which a videotape can and should be cleaned, and all can be situationally appropriate, depending on the tape's symptoms. A trained technician can determine when to use any of these techniques; this paper will try to detail the more popular methods of videotape cleaning within the archival community and explain the pros and cons of each.

Videotape was never manufactured with any sort of longevity in mind. The rapid decay of videotape was first noted in the 1970s and hasn't gotten dramatically better since. Digital Betacam is the only popular format that can be ranked as 'low risk' for deterioration that was readily manufactured[1]. This problem lies in videotape's composition. Generally, videotape is made up of three layers: the back coat, the base and the binder/magnetic layer. The back coating, since the late 1960s has been composed of a thin carbon layer that is conductive so as to deter static electricity from building up. This is helpful to a certain degree as it helps prevent dust and dirt accumulation on the tape. (This back coating also facilitates a uniform tape pack in such a way that each layer of tape clings to one another and ideally will not move.) The base film has

[1] Richard Keatinge. *Causes and Measurement of Videotape Decay*. Publication. N.p.: Broadway Video Digital Media, 2009. Print. Page 4.

typically been made of polyester since the 1960's and provides a solid foundation on which the magnetic layer, attached to the base film by way of the binder, rests.[2] Despite this composition of the base, static is still generated - a side effect of tape playback[3] - which in turn naturally attracts dirt and dust particles. These naturally occurring attractions illustrate why tapes must be periodically cleaned to ensure quality playback. This is certainly not a methodical practice, but Mark Schubin[4] recommends the tape be cleaned at least when it comes out of the archive.

The true issue with videotape preservation, though, lies in its' top - usually referred to as the 'binder' - layer. In addition to simply being physically frail, the binder layer's chemical makeup is simply not one that was ever designed for longevity. Each binder is different from manufacturer to manufacturer, but is mixed in with its magnetic layer and a concoction of a glue, lubricant and cleaning agents with the magnetic layer, oxides (solely until 1987) or metal particles (introduced in 1987), making up the video signal.[5] More recent tapes, produced after the 1970s, also include an anti-fungal agent. (Tapes manufactured prior to this advancement have the capacity to grow legitimate mushrooms on their surfaces.) In the late part of the 1960s, videotape manufacturers started using polyester urethane in their binders both for its durability and as an effort to save on overhead cost. What wasn't readily known at the time, however, is that polyester urethane is easily prone to hydrolysis. This form of binder deterioration is,

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[2] Jim Wheeler *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. Page 4.
[3] Deirdre Boyle. *Video Preservation: Securing the Future of the Past*. NYC: Media Alliance, 1993. Print. Page 23
[4] Boyle, Page 24
[5] Jim Wheeler. *Videotape Preservation Handbook.* N.p.: Association of Moving Image Archivists, n.d. 2002. Web. Page 5.

basically, tape losing its adhesive qualities over time,[6] and is caused by the binder absorbing water molecules from the air. The water breaks down in to two compounds, hydrogen ions and hydroxyl ions, and parts of the polyester urethane chain break apart from one another, and rise to the top of the binder layer, becoming chemically separate from the substrate. As the molecular structure of the tape is compromised, it starts to separate from the substrate - this symptom is known as 'binder shed', also known as 'sticky-shed syndrome'. As this process occurs, chemical deterioration affects the quality of the tape, causing softness and brittleness. This symptom shows itself in two ways: either a sticky residue on the oxide side of the tape and/or as a white powder that can be misinterpreted as mold by an untrained technician. Pip Laurenson, Sculpture Conservator of Electronic Media at The Tate, makes note that sticky shed is rarely visible unless incredibly advanced. Most tapes aren't physically sticky to the touch, but most will begin to clog the video heads if played back.[7] When the tape is in advanced stages of binder shed, it can interfere with playback in a drastic way - the separation from the substrate causes the magnetic particulates to be rearranged and/or lost. This in turn causes color loss and signal dropouts in addition to contaminating any machine on which it is place.[8]

This chemical reaction occurs no matter what, but is easily exacerbated and quickened by high temperatures and high relative humidity. The Jet Propulsion Laboratory has conducted studies on binder hydrolysis within relationship to varying temperature and RH, and developed mathematical equations that showed all tapes would undergo hydrolysis and only low RH levels could decrease the rate of speed of the deterioration. Preservation's answer to this crisis must

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[6] Richard Keatinge. *Causes and Measurement of Videotape Decay*. Publication. N.p.: Broadway Video Digital Media, 2009. Print. Page 7.
[7] *Playback*. Bay Area Video Coalition, 2003. DVD.
[8] Richard Keatinge. *Causes and Measurement of Videotape Decay*. Publication. N.p.: Broadway Video Digital Media, 2009. Print. Page 7.

either be migration or digitization, but to do either of these things, the tape must be able to be played back.[9]

While the polyester base film can theoretically last for hundreds of years under the right conditions, the binder layer is not afforded such longevity. There is no real standard for the estimation of tape life, and while archives can control the conditions in which tapes are kept (ideally dry and cool temperatures), in the broad scheme of things, these storage conditions may not have as much of an affect as professionals would like. For example, some of the oldest magnetic tapes (albeit audio tapes) in the world, from 1943, are still in excellent playing condition, other tapes produced at a later date can be in much worse condition.[10]

Tape cleaning should not be a routine procedure throughout the tape's life. There are instead specific conditions in which a trained technician evaluates the tape and will then determine if the tape is in need of maintenance. Several symptoms warrant cleaning: if debris (dirt, dust, hair, etc) or decay (mold, aforementioned sticky shed) are visible, the tape is in need of attention before it is played back. If the tape and the video head are separated even by seven millionths of an inch, playback can be affected, resulting in a possible 50% loss of signal.[11] If the tape doesn't play back smoothly and exhibits skidding or sticking, the tape should also be cleaned before it is run through a player. AMIA recommends that tapes are cleaned before being housed in archival conditions.[12] Cleaning also becomes necessary before digitization, so as to have the cleanest, most genuine copy possible. Amidst all of these specific times to clean a tape

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[9] Richard Keatinge. *Causes and Measurement of Videotape Decay*. Publication. N.p.: Broadway Video Digital Media, 2009. Print. Page 3.
[10] Jim Wheeler. *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. Page 6.
[11] "Why Do Tapes Require Maintenance?" *BOW Industries*. BOW Industries. Web. 8 Nov. 2015.
[12] Jim Wheeler. *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. Page 22.

though, truly the only time a videotape should be cleaned with any sort of frequency or pattern is when it is affected to a great degree by sticky shed. This is because hydrolysis, once past a certain point, will progress no matter what is done to curb its' advancement.[13]

New tapes also need to be cleaned before use, as the manufacturing process leaves debris on the surface. Brand new tapes should also be burnished, as the tape itself is incredibly abrasive before use, even more so than a contaminated tape. This abrasiveness can harm video heads. Roughly eighty percent of contaminants on a tape's surface can be easily wiped away, but the remaining twenty percent become embedded into the tape's surface. Being run past a sapphire blade or burnishing post will remove these contaminants.

There are two main ways to clean tapes - hand and machine cleaning. There is no one specific way or technique that adequately cleans all tapes in all situations. There is no rote method that is applicable to all situations. Each tape must be assessed individually and each method of cleaning must be viewed as a tool that could potentially help preserve the life of the tape. Whatever is best for the tape decides what tactic a moving image archivists chooses. Jim Wheeler advises that tapes only be cleaned if they are shedding or clogging heads.[14] Some 1/2" tapes can become incredibly sticky - too sticky to be run on a cleaning machine. Vidipax, a now defunct video preservation company, modified an old Ampex machine to cycle the tape back and forth. An operator then holds a denim-like wipe material by hand over the surface as it is run first forward, and then in reverse. Because this is by hand, it has the advantage of cleaning the heads and tails of tape, whereas a cleaning machine would leave the first minute or so untouched. There are other situational, more obscure, cleaning approaches: in the case of old Quad and 1"

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[13] *Playback*. Bay Area Video Coalition, 2003. DVD.
[14] Jim Wheeler. *Video Q&A.* Hollywood, CA: Association of Moving Image Archivists, 2004.Web. Page 13.

tapes, some were attached to flanges with foam that, over time, deteriorated into a honey-like substance and covered the surface of the tape. Vidipax then would put the tape on film cranks and use particular 3M cleaning chemicals and remove the contaminants by hand.[15] A tape that has particularly bad shed will have to be cleaned again in the (relatively) short future in order for it to maintain its playback capabilities, and eventually will be rendered unplayable due to the magnetic particle loss from the binder. Ultimately, tape cleaning is a temporary solution and endangered tapes should be migrated or digitized.[16]

Hand cleaning is the most accessible form of cleaning available to an archivist, as the materials used - a lint-free, soft, fabric - is infinitely cheaper than any machine cleaner available. The most popular choices seem to be either 3M's Pellon (sometimes also used as interfacing in garments) or 3M's #610 Tape Cleaning Fabric[17]. A trained archivist will run a tape on a machine, but before it reaches the heads, will hold the fabric to the tape on both sides, applying enough pressures to let particles attach to the Pellon or Tape Cleaning Fabric, but not so much that it has any stressed place on it as it passes through the machine. Several passes using the Pellon fabric may be required for severely affected tapes, as the Pellon is easily contaminated and serves little purpose once the shed saturates its surface. (It is important to note that while mold effected tapes can be cleaned by hand, to prevent the archivist from being exposed to the spores, the fungus must be either killed or vacuumed away first.) As far as some archivists are concerned, this is the only acceptable hand cleaning practice, and is the gentler option as

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[15] *Playback*. Bay Area Video Coalition, 2003. DVD.
[16] Jim Wheeler. *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. Page 7.
[17] Helen P. Harrison. Audiovisual Archives: A Practical Reader. Paris: General Information Programme and UNISIST, United Nations Educational, Scientific and Cultural Organization, 1997. Print. Section 7.3

compared to some machine cleaning - buffing and scraping the tape are generally treated with more caution as this process can have a harsh effect on the tape.

Cleaning videotape by machine is a broader subject than by hand. To begin with, there are several different types of machines, dependent on format and on processes by which the machines function. For example, Research Technology International, or RTI, a company who manufactures optical disk, videotape, film, and digital equipment, currently offers seven different models of videotape cleaners, each one dedicated to a different format. Some cleaning machines use fabric - or Pellon - wipes, some use vacuum heads to lift off the contaminants from the videotape's surface, and different types of machines also use sapphire 'blades', finely calibrated, to scrape the contaminants or residue off and away from the tape's surface. Each process handles some tape symptoms better than others. For example, Jim Wheeler, in response to an AMIA newsletter question, points out that tapes with shedding debris on their surface should only be cleaned with a vacuum head or pellon wipe system.[18] He notes that a system with the specialized blades must always be kept immaculately clean or they will likely do more damage to the tape than they benefit it. Furthermore, a tape with splices should never be used with the blade system - the distance between the blade and tape is (ideally) so finely calibrated that the splice can become caught. However, due to the way video signal runs at a diagonal, splices are rare.[19]

Today, one of the most affordable cleaning systems is developed by Research Technology International, or RTI. RTI makes a wide variety of products, including the line of TapeChek video cleaners. They offer seven different models total to handle VHS tapes, U-Matic

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[18] Jim Wheeler and Jim Lindner. *Video Q&A.* Hollywood, CA: Association of Moving Image Archivists, 2004.Web. Page 6.

[19] Jim Wheeler. *Videotape Preservation Handbook.* N.p.: Association of Moving Image Archivists, n.d. 2002. Web. Page 9.

Cassettes, DVPRO and DVCAM Cassettes, Betacam, and 1" reel to reel. In 2002, BAVC describes their VHS cleaner as having been purchased for three or four thousand dollars - not inexpensive, but not top of the line, either.[20] The TapeChek system comes equipped with both a cleaning system and a burnishing system. The cleaning system consists of three cleaning modules, one on the back, the other two on the binder side, that are vacuumed assisted to remove shed or dirt before and after polishing.[21] 'Polishing' is the term that RTI uses for the tapes passing by dual sapphire burnishing posts. The Stanford Media Lab, a part of Stanford University Libraries, uses RTI machines, but have removed the burnishing blades installed in the tape path. While helpful in removing sticky shed, it is too aggressive for preservation purposes. These types of machines are truly designed with repurposing the tape in mind - erasing it for potential future reuse.[22] RTI markets its products as tape evaluators, but there is some debate as to how reliable the information gathered by the machine is. The same tape that was cleaned multiple times in a row showed different defect detection results from pas to pass - this tape also exhibited no playback or visually apparent issues at all.[23]

The Recotec is a unique cleaning system that, amongst other archival operations, the Bay Area Video Coalition, BAVC, uses. It was originally intended to clean computer tapes and manufactured around 1970, but was modified in 1993 to support reel-to-reel tape. At the time of

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[20] Sherry Hocking, Jonathan Selsley, and Luke Hones. "Issues in Physical Preservation." Looking Back/Looking Forward: A Symposium on Electronic Media Preservation. 1 June 2002. Lecture. Page 31.

[21] "Operator Instruction Manual for Videotape Inspector/Cleaners." For Models TapeChek 460, TapeChek 470, TapeChek 480, TapeChek 490 (1994). Print.

[22] Michael Angeletti. "Re: MIAP student videotape question." Message to the author. 28 Oct. 2015. E-mail.

[23] Kara Van Malssen. *RTI VT-3100 3/4" U-Matic Cleaning Machine Tips and Guidelines.* N.p., Apr. 2006. Web. 01 Nov. 2015.

purchase, BAVC paid around fifteen hundred dollars for a second hand machine circa 1996.[24] The machine wipes debris away from the surface using Pellon rolls before subjecting it to a vacuuming process. The Recortec also boasts a sapphire burnishing post, so care extra care should be taken if there are any imperfections on the tape's surface for fear of further damage. Jonathan Selsley, a technician who worked for BAVC in 2002 even described moving the blade as they were finding edge damage on the cleaned tapes.[25] The third step the tape undergoes on the machine is exposure to a main vacuuming chamber, which removes any debris that was shaken up by the burnishing post. The final step are a series of smaller vacuums that clean the face, the spine, and then the face again of the tape before being wound onto the take-up reel. The entire reel is run in fast forward once before rewound - this entire process defines one 'pass' of the tape through the Recortec cleaning machine. What is particularly interesting about the Recortec is the tensioning system - each head moves at the same speed, instead of the takeup reel doing all the work. Combined with the vacuum tube, these two features provide a cleaning environment that is almost tension-less, which is an extreme advantage.[26] BAVC has done tests of tape quality, subjecting one tape to twenty passes on this cleaning machine, and have found that the tape experiences no degradation of playback. BAVC also cleans the entire tape path on the machine by hand with Pellon and denatured alcohol in between every half pass of cleaning. Their experiences with tape cleaning on this particular machine show that four to five cleaning passes render a tape adequately cleaned for archival ingestion. This is determined simply by

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[24] Sherry Hocking, Jonathan Selsley, and Luke Hones. "Issues in Physical Preservation." Looking Back/Looking Forward: A Symposium on Electronic Media Preservation. 1 June 2002. Lecture. Page 12.
[25] Hocking, Page 8.
[26] Sherry Hocking, Jonathan Selsley, and Luke Hones. "Issues in Physical Preservation." Looking Back/Looking Forward: A Symposium on Electronic Media Preservation. 1 June 2002. Lecture. Page 7.

sight - after the first pass, the Pellon that that came in contact with the tape's surface is soiled, but after the fourth or fifth pass, the Pellon looks hardly used.[27] At a minimum BAVC runs the tape twice at ten to fifteen minutes per pass, while some incredibly dirty tapes take eight to ten passes. Selsley describes how occasionally the first pass of cleaning will expose a layer of mold, where the second pass will then actually clean away debris.[28]

BOW Industries, out of Manassas Virginia, manufactures four different models of tape conditioners. While these machines clean the tape, they also put emphasis on the importance of a well wound reel for longevity. Three of the four, models 432, 532, and 632, are designed to handle open reel tapes, from 1/4" to 2" tape. The fourth model, the CD1200A, is designed to take D1 and D2 cassettes, both digital tape. All of the models are designed with cleaning tissue stations and a sapphire cleaning blade - what is nice about the BOW equipment is that this sapphire blade can be pivoted out of the way for a 'tissue cleaning only' mode. Two of the models, the 632 and 432 also can be manufactured with an optical inspector, which observes the tape, and stops movement on any defect on the surface to avoid damage. [29] The open reel models feature alternate tape speeds in case there are issues with stiction - a contraction formed from stickiness and friction, where the binder is soft and either sticky and grabbing onto the video heads, or being soft and compressed smooth so as it doesn't grab against the tape path enough.[30]

Erik Piil, an adjunct professor at NYU and conservator at the Kramlich Collection, has begun the efforts to develop an open-source tape cleaning machine for analog tapes. On his

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[27] *Playback*. Bay Area Video Coalition, 2003. DVD.
[28] Sherry Hocking, Jonathan Selsley, and Luke Hones. "Issues in Physical Preservation." Looking Back/Looking Forward: A Symposium on Electronic Media Preservation. 1 June 2002. Lecture. Page 11.
[29] "Tape Cleaners & Certifiers." *BOW Industries*. BOW Industries. Web. 8 Nov. 2015.
[30] Deirdre Boyle. *Video Preservation: Securing the Future of the Past*. NYC: Media Alliance, 1993. Print. Page 23.

webpage on GitHub, he details how to assemble an open reel magnetic videotape cleaner. What he calls the OpenCleaner uses two motors per spindle drivetrain that propels the tape past two Pellon rolls. It uses sensors to monitor the tape's tension and speed, and then provides feedback to the machine's circuit boards. The default motor spindles can accomodate ½" video and ¼" audio tape, but the project has plans to build spindles for tape that has been removed from the ¾" U-Matic and VHS cassettes. The advantage of this project being open source and on GitHub is that others can adapt the plans without affecting the original. Furthermore, plans are accessible to the public, so with some knowledge of electronics, nearly anyone can build their own cleaning machine. Depending on cost of parts, this could potentially be cheaper than a cleaning machine at retail, and allow for more specific customization. Depending on the projects started in archives, this could help manage all different types of formats or tape deterioration on one machine, creating a more streamlined work flow for conservationists.[31]

While cleaning machines have been used for many years within the archival community to eliminate binder shed, one more recent alternative has come about with preservation especially in mind. This system, branded SAMMA (System for Automated Migration of Media Assets), is an entire line of products dedicated to an archival focused migration workflow. It is designed to ingest videotapes - U-Matic, Betacam, or VHS tapes can be inspected and cleaned within the SAMMA Clean system before they are digitized either within the SAMMA Robot or SAMMA Solo. At every step of the way, these products are gathering metadata about the tape itself and is then output in a report in the appropriate .xml file format. The SAMMA Clean system is particularly interesting in the way it handles the videotape itself. It uses dry Pellon rollers to

[31] Erik Piil. "Open-Cleaner." An In-progress Open-source Tape Cleaning Solution for Analog*Video Preservation.* N.p., n.d. Web.

remove the binder shed, as is typically found in most cleaning machines, but also claims a 1/10th playback tension when compared to a VTR machine. Even more interesting is its inspection capabilities: two optical sensors are set up and designed to detect damage on the tape's surface. One is for measuring reflectivity (changes in reflected light indicate surface damage)[32] while the other measures tape width.[33] Readings on tissue dirt and the torque of the pack are also recorded.[34] This data is then packaged with the other metadata, fulfilling both an archival goal and a preservation goal. The SAMMA clean operates in a standard fashion. One full pass - a forward run and a reverse run on the machine is what is to be claimed as all that is needed to thoroughly clean a tape enough to be digitized.[35] The true advantage of this system is that it is one streamlined workflow - from start to finish, metadata is gathered, the quality of the tape is protected as is best possible, and an access copy is created.

A component of keeping videotape clean is to also maintain the cleanliness of the playback machines at the archivists' disposal. It is irrelevant to clean a tape if the tape is then run through a system with contaminated video heads. Not only is playback obviously affected, but this just serves to re-contaminated the videotape, making it necessary for another tape cleaning session. Clogged video heads are fairly obvious - one clogged head will still show a picture, but every other line will be filled with noise. Both clogged heads typically result in the entire imagine compromising of noise.[36] Jim Wheeler recommends using cleaning cassettes that contain Pellon as the best way to clean cassette recorders and advises that only correctly trained

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[32] "SAMMA Robot Brochure". Louisville: Front Porch Digital, 2008. Web.
[33] "SAMMAsolo Brochure". Louisville: Front Porch Digital, 2011. Web.
[34] Koa Luke. "Cleaning Videotapes for Preservation." *Uluulu The Henry Kuualoha Giugni Moving Image Archive of Hawaii*. 1 Oct. 2012. Web. 29 Oct. 2015.
[35] "Videotape to Digital Files Solutions." (2008). Front Porch Digital. Web.
[36] Charles Besinger. *The Video Guide*. Santa Barbara CA: Video-Info Publications, 1981. Print.

archivists even attempt reel-to-reel cleaning.[37] Typically, a videotape recorder, or VTR, will have a manual, and will address the recommended cleaning procedures. However, some archivists don't recommend cassette cleaners at all, as they tend to scrub dirt away from the center of the head, but redirect it up and down on the head towards the grooves, further clogging them. This then contaminates videotape that is run through the machine. Schubin recommends solely cleaning the playback machine by hand or by running a blank tape through the machine (to pick up the contaminants on the heads).[38] The Bay Area Video Coalition out of San Fransisco, California, a rather large video preservation center, prefers to clean their video heads with denatured alcohol and Pellon by hand[39]. Cassette cleaning a VTR is thoroughly less complicated and involved than hand cleaning a VTR. Technique obviously varies from model to model - of which there can be many, considering the plethora of formats that video has been manufactured in over the years. In addition to a trained archivist cleaning the VTR heads, by which you can use a head spray cleaner or Pellon, it is sometimes necessary to clean the machine's slip rings and tape paths. Slip rings are how the tape information is transferred from the heads to the internal electronics and tape paths are physically where the tape travels around the head drum. The machine's housing should also be cleaned - the whole system must be kept as clean as possible, or the video heads and tape will fall into contamination exponentially quicker.[40]

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[37] Jim Wheeler. *Videotape Preservation Handbook.* N.p.: Association of Moving Image Archivists, n.d. 2002. Web. Page 10.
[38] Deirdre Boyle. "Symposium on Video Preservation." *Video Preservation: Securing the Future of the Past*. NYC: Media Alliance, 1993. Print. Page 24.
[39] *Playback*. Bay Area Video Coalition, 2003. DVD.
[40] Charles Besinger,. *The Video Guide*. Santa Barbara CA: Video-Info Publications, 1981. Print.

Mold is another reason videotape must be cleaned, but it shouldn't be accomplished by simply running the tape through a cleaning machine, even though it is done by some professionals, or even be dealt with by hand cleaning at first. Mold can grow on video in as quickly as a few weeks if the environmental conditions are catalytic enough. There are a few recommended ways of getting rid of the mold, which must be accomplished before actually traditionally cleaning the tape itself. One way is to vacuum it away with a HEPA vacuum. The archivist should be in protective gear to avoid any exposure to the mold spores.[41] Another method, as described by Peter Brothers of Specs Bros., LLC, details how the mold must be driven into dormancy by climate control (less than 30% RH) before being run through a cleaning machine. This creates problems, though, as it sends mold spores flying in every direction, all over the machine, the room, and the operator. Technicians can use Tri Chlor (methyl chloroform) in cases of severe - heavily visible - mold infection. This chemical cleaner not only removes visible mold but kills any mold spores it comes in contact with. While Tri Chlor will not effect any stable tapes, it will interact with decaying tapes and with the plastics in the reels and cassettes. Peter Brothers recommends removing the videotape from any shell and cleaning them both separately for both ease and sanitation.[42]

There are other reasons for cleaning tapes besides binder shed and the typical accumulation of dust. Particular procedures must be followed in emergency situations. These are not general treatment operations, but treating and cleaning tapes appropriately can save the materials from destruction. Treating tapes inappropriately can damage them further, even going

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[41] Peter Brothers. "Re: [AMIA-L] Handling U-Matic Tapes with Mold." Message to Taz Morgan. 29 July 2011.
[42] Peter Brothers. "Re: cleaning mold on videotapes- reposted." Message to Allan Goodrich. 18 December 2014. Email.

so far as to destroy them. The National Archives and Records Administration Preservation Programs has published a three-page paper on the appropriate responses for magnetic medias, both in cassette form and on reels. Most tapes can handle being submerged in water - what is problematic are any potential contaminants, like sewage, salt, or chlorine that may adhere to the surface if the tape dries before they are removed.[43] Mold and fungus also can begin growing within the timespan of twenty four hours.[44] If contaminated, oxide tape (such as Quad, 1" tape, U-Matic and VHS) is perfectly safe to be washed with *distilled* water. It is incredibly important to point out, however, that Metal Evaporated and Metal Particle tapes should never be subjected to water exposure if it can be helped, as they will be permanently damaged. Contaminated cassettes are immersed in a bath of distilled water and wiped clean before being injected with another bath inside the cassette itself and shaken (this step is repeated two times) before being allowed to air dry. Reel-to-reel tape, due to the difference in format, sits in an agitated bath of distilled water that is refreshed two times before also being allowed to air dry. Wet tape is extremely fragile and susceptible to tearing at stretching.[45] Furthermore, if the tapes dry unevenly, they can lose their uniform shape, becoming unplayable. Even if tapes aren't submerged in water but simply in a flooded room, hydrolysis will catalyze at an aggressive rate and contaminants will cover the surface with ease.

Tape baking is an alternative solution to playback issues and binder shed, but is more of a last resort attempt to play the tape for migration. While baking attempts to deal with sticky shed

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[43] "Magnetic Tapes - Audio, Video, and Data Storage Tape." National Archives and Records Administration Preservation Programs (20 Apr. 2009): n. pag. Web.
[44] Jim Wheeler. *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. Page 27.
[45] "Magnetic Tapes - Audio, Video, and Data Storage Tape." National Archives and Records Administration Preservation Programs (20 Apr. 2009): n. pag. Web.

by using heat to adhere the loose particles back to the binder. Unfortunately, the heat also effects the rest of the tape, and each component of the tape is affected with distinct characteristics. As the tape cools, even though the heat temperatures it has been subjected to haven't been great, the materials all contract in different ways and stress the tape in an unnatural way.[46] Anthony Matt, once a Video Restoration Specialist at the now expired Vidipax, details how tape baking can accelerate the deterioration considerably by loosening the binder. When re-examining a tape sometime after it has been baked, it is not uncommon for the tape to be on the verge of falling apart.[47] Simply cleaning the videotape is considerably less invasive - no chemical change is taking place within the tape's materials, which postpones deterioration as long as possible, whereas baking a tape can actually make the tape's condition worse.

There are of course defunct cleaning methods - Tapeography was a Canadian company, that, among other products, produced a machine called the Sofblend. This was a fairly popular line of videotape cleaning machines, but the line was discontinued in April 2002 due to diminished demand as the format encroached further into obsolesce. A short while later, Tapeography went out of business entirely.[48] Even Recortec is truly out of the cleaning machine business, but as of 2002 had spare parts around for repairs or some custom orders.[49]

Though the process of tape cleaning and its affects are vague at best, there is some fear that the removal of shed that has raised to the surface also, eventually, will compromise the data available in the oxide binder layer and degrade playback overtime. There has been no conclusive

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[46] Crystal Sanchez. *Heating Things Up: A History of Baking Tapes for Video Preservation.* 2010. Web.
[47] *Playback*. Bay Area Video Coalition, 2003. DVD.
[48] "VIDEOTAPE CLEANERS." *Tapecleaners*. Tapeography, n.d. Web. 11 Nov. 2015.
[49] Luke Hones, Sherry Hocking, and Mona Jimenez. "Tape Preparation and Cleaning." *Reel to Real: A Case Study of BAVC'S Remastering Model*. Bay Area Video Coalition, 2002. Web. 11 Nov. 2015.

study done on this process, and therefore there are very little facts to back up this fear, but it is a logical one. No matter the process by which the tape is cleaned, by cloth wipe, burnishing post, or vacuum, physical parts of the binder and original video signal are removed. The unknown is at what rate and how severely this could become a factor.[50]

Ultimately, videotape cleaning is a specialized skill that requires a technician with extensive knowledge on the composition of tape and how tape physically behaves. Inspection is crucial to tape cleanliness – without proper evaluation, a technician runs the risk of improperly treating a tape and thus damaging it, possibly irreparably. Different degrees of deterioration must be assessed and cleaned individually – severely decayed tapes, in most cases, can't be cycled on a cleaning machine and can only be dealt with by hand. Hopefully tapes aren't cleaned with any predictable schedule, but it is absolutely common practice for archivists to clean a tape before digitization. Other than this circumstance, tape cleaning is generally only performed as needed. The better the conditions the tape itself is kept in – appropriate RH and temperature being key factors – delay the generation of sticky shed, which in turn eliminates a need for tape cleaning. As far as the goal of preservation is concerned, this method is more effective than baking videotapes, but goes no further towards solving the problem of the fallibility of the tape format. Cleaning is truly only a way to delay the inevitable, with the hopes that it is done soon enough that the content can be migrated from format to format so the data is accurately preserved.

Works Cited

[50] *Playback*. Bay Area Video Coalition, 2003. DVD.

Angeletti, Michael. “Re: MIAP student videotape question.” Message to the author. 28 Oct 2015. E-mail.

This paper’s author originally emailed questions to BAVC employees. When they couldn’t answer the questions, they forwarded it on to Michael Angeletti, who briefly responded to questions about the history of video cleaning and competing processes.

Besinger, Charles. *The Video Guide*. Santa Barbara CA: Video-Info Publications, 1981. Web. <http://videopreservation.conservation-us.org/vid_guide/>

A comprehensive guide found online but originally available in print. It covers all video topics from signal to maintenance and repair. This was used for its information on VTR cleaning and maintenance.

Boyle, Deirdre. *Video Preservation: Securing the Future of the Past*. NYC: Media Alliance, 1993. Print.

This book is a conglomerate of information given at a symposium including a survey of collections, a write up of the talks that happened at the symposium, a list of the symposium participants, a ‘preservation update’ and a glossary.

Brothers, Peter. “Re: [AMIA-L] Handling U-Matic Tapes with Mold.” Message to Taz Morgan. 29 July 2011. <http://lsv.uky.edu/scripts/wa.exe?A2=ind1107&L=AMIA-L&P=R61313&I=-3>

In the AMIA listserv, Peter Brothers joins in on a conversation about how to eliminate mold from videotape by way of dormancy or killing the spores themselves. It is all practical advice, given from experience rather than simple fact.

Brothers, Peter. “Re: cleaning mold on videotapes- reposted.” Message to Allan Goodrich. 18 December 2014. Email.
<http://lsv.uky.edu/scripts/wa.exe? A2=ind1412&L=AMIA-]L&P=R35977&I=-3>

Peter Brothers’ AMIA listserv repost of how he treats videotapes with mold that are in cassettes. He talks briefly about appropriate cleaning procedures and cleaning chemicals. He also talks about cautions that should be taken and insider tips that would only be known to someone with experience.

Harrison, Helen P. Audiovisual Archives: A Practical Reader. Paris: General Information Programme and UNISIST, United Nations Educational, Scientific and Cultural Organization, 1997. Section 7.3. Web.
<http://unesdoc.unesco.org/images/ 0010/001096/109612eo.pdf>

A very large reader about audiovisual materials. Section 7.3 is specifically on magnetic tape decay and how to treat such issues.

Sherry Hocking, Jonathan Selsley, and Luke Hones. "Issues in Physical Preservation." Looking Back/Looking Forward: A Symposium on Electronic Media Preservation. 1 June 2002. Lecture. <http://www.imappreserve.org/pdfs/Educate_Train_pdfs/LookingForward/PhysicalPreservation.pdf>

A discussion between several industry processionals. Some are from BAVC, and

talk about their use of the Recortec and RTI equipment was especially helpful, as it was real-world, practical information, rather than from the manufacturing companies.

Hones, Luke, Sherry Hocking, and Mona Jimenez. "Tape Preparation and Cleaning."*Reel to Real: A Case Study of BAVC'S Remastering Model*. Bay Area Video Coalition, 2002. Web. 11 Nov. 2015. <http://www.experimentaltvcenter.org/tape-preparation-and-cleaning#jump>

A brief summary of how BAVC came to clean tapes - they skipped over washing and baking. They outline how they use the Recortec and RTI cleaning machines.

Keatinge, Richard. *Causes and Measurement of Videotape Decay*. Publication. N.p.: Broadway Video Digital Media, 2009. Web. <http://sportsvideo.org/main/files/2010/08/video-tape-white-paper.pdf>

This paper outlines different formats, binder hydrolysis, magnetic remanence decay, risk of tape dependent on format, migration, and digitization. Its information on binder shed was especially useful for putting videotape cleaning into context.

Luke, Koa. "Cleaning Videotapes for Preservation."*Uluulu The Henry Kuualoha Giugni Moving Image Archive of Hawaii*. 1 Oct. 2012. Web. 29 Oct. 2015. <http://hkgarchives.org/2012/10/01/cleaning-videotapes-for-preservation/>

A video intern's blog posting at 'Ulu'ulu. The intern outlines how he cleans 3/4" U-Matic tapes wit the SAMMAclean system. He discusses how mold is dealt with, the proper procedures for ingestion and digitization and what metadata the SAMMAclean collects.

"Magnetic Tapes - Audio, Video, and Data Storage Tape." National Archives and Records Administration Preservation Programs (20 Apr. 2009): n. pag. Web. <https://www.archives.gov/preservation/records-emergency/pdf/audio-video-tapes.pdf>

NARA's procedures for how to treat magnetic material after it has been exposed to water damage and flooding. It outlines what not to do to the tapes, plus the appropriate steps that should be taken to wash the tapes of any contaminants and how to dry them.

Piil, Erik. "Open-Cleaner." An In-progress Open-source Tape Cleaning Solution for Analog*Video Preservation.* N.p., n.d. Web. <https://github.com/epiil/open-cleaner>

An open-sourced set of instructions to build, test, and operate an open-reel videotape cleaner. The project is in-progress and is only intended for 1/2" and 1/4", though plans for 3/4" are in the works.

Playback. Bay Area Video Coalition, 2003. DVD.

Bay Area Video Coalition's DVD on their preservation case study of *The Eternal Frame*. It showcases talks with the artists, how the material is cleaned and digitized, and any adjustments that need to be made to make the digital copy resemble the original.

Research Technology, International. *Service Manual: TapeCheck Model 4100.* Lincolnwood IL: Research Technology, International, Unknown. Web. <http://www.broadcaststore.com/pdf/model/815196/4100servman.pdf>

A service manual for the TapeChek Model 4100, a cleaner/evaluator for Betacam tapes. It details the parts of the machine, and brief service info on the product.

"SAMMAsolo Brochure". Louisville: Front Porch Digital, 2011. Web. <http://www.rexfilm.hu/documents/document/document/2808/SAMMA_Solo-Overview.pdf>

This is sales brochure for the SAMMAsolo, listing technical specifications for the product, and how it fits into the overall SAMMAsystem.

"SAMMA Robot Brochure". Lousiville: Front Porch Digital, 2008. Web. <http://www.rexfilm.hu/documents/document/document/2809/SAMMA_Robot-Overview.pdf>

A sales brochure for the SAMMArobot. This brochure talks about migration workflow, how the robot ingests tapes, what data it gathers, and how the SAMMA system works.

Sanchez, Crystal. *Heating Things Up: A History of Baking Tapes for Video Preservation.* 2010.Web. <http://www.nyu.edu/tisch/preservation/program/student_work/2010fall/10f_2920_sanchez_a2a.pdf>

A final paper for the MIAP program's Basic Issues and Training Class, regarding tape baking. The paper puts the 'method of tape baking in context' and describes the process of baking and how it started. It is used to contrast cleaning with baking and the invasiveness of two processes.

"Tape Cleaners & Certifiers."*BOW Industries*. BOW Industries. Web. 8 Nov. 2015. <http://www.bowindustries.com/Tape%20Cleaner%20Index.htm>

BOW Industries' tape cleaning product page. It gives brief descriptions for the four models that the company makes and allows for redirection for more information on the specific models individually.

Van Malssen, Kara. *RTI VT-3100 3/4" U-Matic Cleaning Machine Tips and Guidelines*. N.p., Apr. 2006. Web. 01 Nov. 2015. <https://www.nyu.edu/tisch/preservation/program/student_work/2006spring/06s_3403_vanmalssen_a3.doc>

An overview of the RTI U-Matic cleaning machine, covering uses, operation, and issues. This was originally written by a student of the MIAP program for the NYU Bobst Library Preservation Lab.

"VIDEOTAPE CLEANERS."*Tapecleaners*. Tapeography, n.d. Web. 11 Nov. 2015. <http://www.sofblend.com/cleaner.html>.

Tapeography's website announcing their discontinuing of tape cleaning products and their closing of the company.

"Videotape to Digital Files Solutions." (2008). Front Porch Digital. Web. <http://www.broadcaststore.com/pdf/model/814400/SolutionBrochure_Low.pdf>
This .pdf is a brochure advertising the advantages to owning a SAMMA system in an archive. It shows the SAMMA system workflow and highlights all the features of both the Robot and Solo systems from ingestion to cleaning and migrating.

Wheeler, Jim. *Videotape Preservation Fact Sheets 1-18.* Hollywood, CA: Association of Moving Image Archivists, 2004. Web. <http://www.amianet.org/sites/all/files/fact_sheets_0.pdf>
A series of eighteen fact sheets that loosely cover the wide range of topics applicable to videotape. Cleaning is mentioned, amongst plenty others, as well as disaster recovery, different formats, environmental conditions, and reformatting.

Wheeler, Jim. *Videotape Preservation Handbook.* N.p.: Association of Moving Image Archivists, n.d. 2002. Web. <http://www.amianet.org/sites/all/files/WheelerVideo.pdf>
A brief paper on what librarians and archivists can do to preserve their videotape collections. More knowledge and training would be required to put the plans into action but it gives people a starting point, and provides enough knowledge to be able to contact the appropriate personnel to handle the job if they cannot themselves.

Wheeler, Jim and Jim Lindner. *Video Q&A.* Hollywood, CA: Association of Moving Image Archivists, 2004.Web. <http://www.amianet.org/sites/all/files/video_q%26a.pdf>
Fifty eight separate answers to questions that were posted in various AMIA Newsletters. The topics range from cleaning to outsourcing questions to compatibility questions to legal questions.

"Why Do Tapes Require Maintenance?"*BOW Industries*. BOW Industries. Web. 8 Nov. 2015. <http://www.bowindustries.com/tmwp.htm>
BOW Industries makes the case for tape cleaning, presenting several reasons why dust alone is enough to warrant a cleaning machine. They also talk about how winding and stacking are advantages for archival tapes, and how their cleaning and burnishing systems provide the best treatment of the tape possible for playback.