

CINE-GT 2920
Fall 2018
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November 19, 2018

Flexplay:
A Time Sensitive Disposable Optical Medium

In 2003, when the Flexplay disc was first introduced to the public, Blockbuster Video was the monolith for DVD rentals and the way to see movies outside of theaters. Flexplay was a DVD-compatible optical video disc format that had a limited playback time, typically 48 hours. After the time limit passed, the disc turned from a clear, red-tinged hue to black and opaque. It was the chemistry of the layers in the disc that caused the disc to "self-destruct" after 48 hours, turning it black and making it unreadable and unplayable. Flexplay Technologies, which conceived of the Flexplay disc, was founded in 1999 by two university professors, who paired with General Electric to create the format. Distribution of Flexplay discs began in 2003 and ended in 2009.¹ Currently, you can only find a smattering of Flexplay DVDs on eBay or Amazon, where they are sold as novelty, collector items.

Flexplay was created as an alternative to using Blockbuster for the short-term rental of DVDs. Instead of worrying about the due date for returning films to Blockbuster, the viewer could

¹ "Flexplay (2003–2009)," *Museum of Obsolete Media*, <http://www.ObsoleteMedia.org/flexplay/>

just throw away or recycle the DVD after using. Flexplay was meant to piggyback off the Blockbuster craze and profit off the unpopularity of late rental return fees. A commercial for Flexplay exclaims, "Think about all of the gas you'll save by avoiding that trip back to the video store!"² Flexplay was interchangeably called the "No-Return DVD Rental" and "the Time Limited DVD." The discs were sold at gas stations, convenience stores, grocery stores, and airports, as well as at Flexplay.com. Flexplay discs were sold at rental store prices, between \$5 and \$7 per movie, but cut out the visit to the rental store. For those who used Flexplay.com, fast and free shipping was provided. The only consolation for Blockbuster was the delayed release of films on Flexplay, which were between two months and two years behind the initial filmic release dates.

²Flexplay08, "Flexplay Commercial," *YouTube.com*, August 1, 2008, www.youtube.com/watch?v=kXGxUjWipQI.



Figure 1. Screenshot of old Flexplay.com home screen³
 Flexplay is an optical disc that is DVD-compatible. An

optical disc is a flat, usually circular disc that encodes binary data, in the form of bits, which are binary digits. The encoding material sits atop a thicker substrate, usually made of a pure polycarbonate plastic. This substrate makes up the bulk of the disc. Optical media "use laser technology for recording, storing, and reproducing digital data."⁴ In order to read the data, a reflective surface is required. This surface is usually a thin backing of aluminum. The layer is protected by a transparent coating.⁵ The light from the laser that is directed on the optical disc, or storage medium, "changes the plastic and

³Chandra Steele, "Great Moments in 'Self-Destructing' Tech," *PCMag.com*, February 27, 2014, <https://www.pcmag.com/feature/321177/great-moments-in-self-destructing-tech>

⁴ Diana Weynand and Vance Piccin. *How Video Works: From Broadcast to the Cloud*. 3rd ed. New York: Focal Press, 2016. 276.

⁵ Weynand, *How Video Works*, 277.

the data is stored as a change in the physical structure of the optical media. This change creates a small spot, or *pit*, when the laser is energized. An area where the laser is off leaves a *flat*, also called a land."⁶ (See Figure 2. Cross Section of an Optical Disc) The pits and flats left by the laser are recorded on the disc in a circular pattern, starting from the center of the disc and circling outward toward the edge. When playing back the DVD, a narrow laser beam shines over the data track of the disc. The laser, constantly shining on the surface of the disk and reflected by the backing, hits the bumps and flats on both reflective layers, and "the beam bounces back to a light reader. As a result of the pits' and flats' different shapes, the pits and flats reflect light differently. The sensor detects the difference, reading the pattern encoded onto the disc as zeros and ones."⁷ The changes between the pits and flats are read as ones and no changes are read as zeros.⁸ Flexplay discs, being commercially pre-recorded, are "produced using a process that molds or stamps the pits into the polycarbonate before the reflective layer is applied. The pits are actual, physical indentations that change the reflectivity of this added layer when read by an optical disc player."⁹

⁶ Weynand, *How Video Works*, 277.

⁷ Tom Harris, "How Flexplay DVDs Work," *HowStuffWorks.com*, <https://electronics.howstuffworks.com/flexplay2.htm>

⁸ Weynand, *How Video Works*, 277.

⁹ Weynand, *How Video Works*, 278.

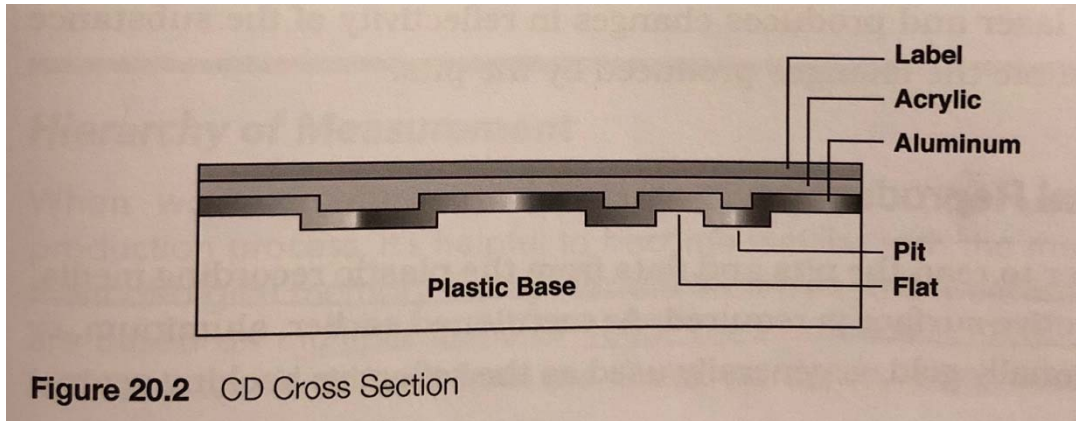


Figure 2. Cross Section of an Optical Disc¹⁰

The most common types of optical media are Blu-rays, CDs, and DVDs. Flexplay discs are not DVDs. However, they are DVD-compatible. "DVD" stands for "Digital Versatile Disc." "Each side of a DVD can contain two layers of data. The layer closest to the surface is burned on a transparent coating that allows the laser to change focus and read the information of the layer behind it."¹¹ DVDs have two reflective layers—an inner reflective layer and a semi-transparent outer reflective layer. The machinery manufacturing the DVDs "bond the two reflective layers together using resin adhesive, which hardens into solid plastic, securing the two sides into a single disc."¹² Other than the special bonding resin, located in front of the inner reflective layer and unique to the Flexplay disc format, Flexplay discs are the same as dual-layer DVD-9 discs. They just do not carry the DVD logo.

¹⁰ Weynand, *How Video Works*, 277.

¹¹ Weynand, *How Video Works*, 282.

¹² Harris, "How Flexplay DVDs Work"

The DVD-9 disc is a single sided (SS), double layered (DL) optical format. (See Figure 3. Types of DVD Layers, bottom right corner) It measures twelve centimeters in diameter and has a disc capacity of 8.54 Gigabytes. It is a DVD-ROM, as opposed to a DVD-R. DVD-ROM stands for "Digital Versatile Disc-Read-Only Memory." DVD-ROMs, including DVD-9s, and as a result Flexplay, are used for commercial distribution of DVDs. These discs are mass produced using "a process of molding and stamping with a glass master disc."¹³ The numbers associated with a DVD refer to a rough approximation of their capacity, hence DVD-9's disc capacity of 8.54 Gigabytes.¹⁴ Since Flexplay discs are equivalent to DVD-9, they can hold up to four hours of standard definition video using MPEG-2 compression.

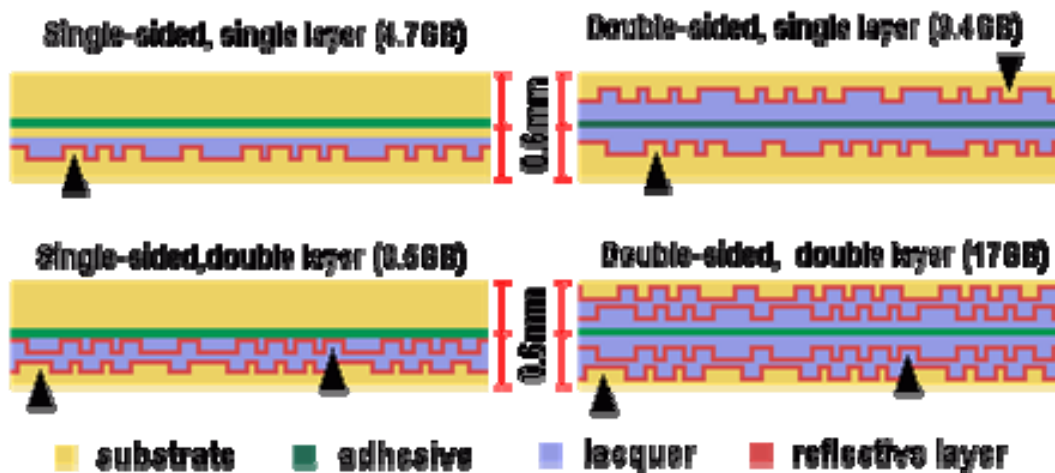


Figure 3. Types of DVD Layers¹⁵

¹³ Weynand, *How Video Works*, 281.

¹⁴ Weynand, *How Video Works*, 282.

¹⁵ "DVDs - digital versatile disks - how they're made and how they work," *PCTechGuide.com*, <https://www.pctechguide.com/dvd/dvds-digital-versatile-disks-how-theyre-made-and-how-they-work>

1. "Unopened Flexplay discs stay 'fresh' in the package for about one year."
2. "Your 48 hours begins when the package is opened."
3. "Watch in any standard DVD player as many times as you like, within your 48 hours."
4. "After 48 hours, the DVD expires and turns black. Just recycle or dispose."

The packaging also advises viewers to visit www.flexplay.com for more information about recycling.



Figure 4. Flexplay Disc Instructions¹⁹

As is vaguely suggested on the Flexplay outer packaging, once the vacuum-sealed package is opened, the disc has been exposed to oxygen and the countdown to expiration and total darkness begins. One patent for the "Directory read inhibitor for optical storage media" describes how the optical disc becomes unreadable. A method was devised

¹⁹ Pierre Dandumont, "DVD jetable : les DVD-D et FlexPlay," *JournalDuLapin.com*, June 4, 2015, <https://www.journaldulapin.com/2015/04/06/a-terminer-dvd-jetable-les-dvd-d-et-flexplay/>

"inhibiting the readability of an optical media due to changes in a pseudo-reflective material that composes the optical media after the optical media has been exposed to air for a predetermined time. An optical media includes a data encoded component. At least a fraction of the data encoded component transforms from a substantially optically reflective state to a substantially optically non-reflective state as at-least-in-part a function of time from an initializing event."²⁰

In other words, an extra layer is added to the standard DVD structure. The specialized layer includes a chemical compound that easily combines with oxygen in the atmosphere to form a new chemical compound. The original chemical compound is transparent, but the new chemical compound is opaque. This new chemical compound causes the DVD to turn black after the 48 hours of exposure to oxygen. What makes Flexplay different than the DVD-9 format is that the polymer resin adhesive that bonds the two layers of the disc together is chemically modified, so that when the disc is exposed to air, it oxidizes. When the vacuum-sealed package is opened, the polymer resin adhesive bonding together the inner and outer layers of the disc, the substrates, reacts to oxygen and oxidizes, turning from clear to black in about 48 hours.²¹ The bonding resin, or adhesive layer, is either polyester resins, epoxy resins, ultraviolet cured

²⁰ Flexplay Technologies, Inc. 2003. Directory read inhibitor for optical storage media. US Patent 6,641,886, filed June 29, 2000, and issued November 4, 2003. <http://patft.uspto.gov/netacgi/nph-Parser?u=%2Fmetahtml%2Fsrchnum.htm&Sect1=PT01&Sect2=HITOFF&p=1&r=1&l=50&f=G&d=PALL&s1=6641886.PN.&OS=PN/6641886&RS=PN/6641886>

²¹ nooruddeenzangi, "How Flexplay DVDs Work," *ATmega32-AVR.com*, September 19, 2013. <https://atmega32-avr.com/how-flexplay-dvds-work/>

organic resins, or vinyl resins. The reactive material on the bonding layer is made up of at least one blocked dye derived by the reduction of a dye selected from azines, oxazines, thiazines, and combinations thereof.²²

Once the Flexplay disc is unhoused from the vacuum-sealed package, the oxygen most likely reaches the polymer resin middle layer between the two substrates by way of the gap between the two layers in the middle of the disc, where the hole is located. In the instance of a Flexplay disc, the gap is left unsealed, which is not the case with DVDs. This is partly because DVDs do not have the extra plastic layer that Flexplay has between the two discs. DVDs are comprised of two separate discs that each have a data track. The two discs are bonded together with resin adhesive. To make a Flexplay disc, the normal resin adhesive is replaced with Flexplay's polymer resin and Leuco dye adhesive mixture that hardens to form the unique and patented plastic layer that causes Flexplay discs to turn black over 48 hours of oxygen exposure.

A blue dye called leuco dye, which is methylene blue reduced by sodium dithionite, is the reason the disc turns black and reacts to the oxygen. Leuco dyes "form the basis of thermal printer papers and certain pH indicators."²³ These dyes are

²² "Leuco dye," *Revolvy.com*, <https://www.revolvy.com/page/Leuco-dye>

²³ "Leuco dye," *Revolvy.com*

cannot get to the inner reflective layer, so the DVD player reads the disc as blank.

Sixty-seven patents were filed between February 18, 2000 and June 11, 2004 to create all the components of the Flexplay disc. The patents list off a multitude of minute differences between different approaches that could all possibly create the effect needed to create Flexplay. For example, for what the disc could react with to obscure a portion of the underlying data on the disc, the patents list:

- Reacting with oxygen,
- Reacting with moisture or gases in the air,
- Reacting to laser light, and
- Reacting to ambient room light

as possible catalysts. The goal with this many patents was most likely to give the inventors enough space to experiment with the process, while having the security of knowing that no one else could swoop in and steal their invention while they were tweaking it. One of the overarching goals in the creation of the Flexplay disc was to make as few and minimal changes as possible to the existing manufacturing processes for the optical discs.

There are not any large preservation concerns about Flexplay. As with all optical media, disc rot *would* be an issue, if the discs stayed around long enough. However, since Flexplay discs are usable for only 48 hours, disc rot is not a concern. Also, although the airtight vacuum-sealed packaging protects the

packaged disc from oxygen exposure, Flexplay discs can only last one year unopened and still be played. The larger concern would be if the vacuum seal of the packaging were broken without the consumer knowing. This would cause the disc to react to the oxygen before the disc could be viewed. Because the films on Flexplay are not anything new or unique and there are most likely already better copies of each film, it is more important to preserve the history of Flexplay and the time period during which it was created.

The reception to Flexplay was not overwhelmingly positive. From the very beginning, it was not a successful medium for a variety of reasons. Test marketing of Flexplay discs began in August 2003. Almost immediately, consumers rejected the concept. Flexplay was not the only limited-play optical disk (LPOD) that was available in the market. In 2003, The Buena Vista Home Entertainment division of The Walt Disney Company used Flexplay Technologies' disc technology for their own time-limited format, which was not particularly successful either.²⁶

There were large environmental concerns about this optical disc format. It was being distributed and sold during a time when America was focused more than ever on combating global warming. Environmentalists were outraged that Flexplay discs

²⁶ "Disney Debuts Time-Limited DVDs," *NACSONline.com* via *web.archive.org*, May 20, 2003, <http://archive.li/1bev6>

were being advertised as disposable, one-time use products. The end result is an unreadable disc, which is useless to the consumer. Despite Flexplay teaming up with GreenDisc, a company that recycles technotrash, those against Flexplay did not change their minds.

Another issue with Flexplay included the individual discs being too expensive, at \$5 to \$7 a disc, for something that could only be viewed a limited amount of times and was then thrown away. The out of date nature of the films by the time the films were released on Flexplay was another issue that negatively impacted the Flexplay brand. To put the nail in Flexplay's coffin, in December 2009, *Gizmodo.com* listed Flexplay as among the 50 Worst Gadgets of the Decade (2000s).²⁷ Needless to say, by the end of 2009, Flexplay, the "Time Limited DVD," was over.

Despite Flexplay no longer having commercial value, I think Flexplay discs would be great as teaching tools. The discs could be used to show a chemical reaction happen before your eyes. In 48 hours, you can see the disc color change from red to black. This change also illustrates two components of the mechanics of optical discs: the layering of the disc and the components needed

²⁷ Brian Barrett, "The 50 Worst Gadgets of the Decade," *Gizmodo.com.au*, December 24, 2009, <https://www.gizmodo.com.au/2009/12/the-50-worst-gadgets-of-the-decade/>

to make a disc function. The opaque nature of the disc literally blocks the laser and renders the disc unreadable.

In the aftermath of Flexplay, Netflix took charge of the mail-in DVD service. Netflix was founded in 1997, before Flexplay Technologies was established. During Flexplay's tenure, Netflix's popularity and distribution continued to grow and by 2007, Netflix added streaming capabilities to its services. With Netflix, you can subscribe to either the physically mailed DVD home delivery service, the streaming service, or both. With the mail service, you just place the films you would like to see in ranking order and Netflix will mail to your address the next DVD in your cue. The DVD arrives with a pre-addressed return envelope, so that when the subscriber is ready to return the DVD, all they need to do is put the envelope in the mail. Once the DVD is received by Netflix, the next cued film is sent to the subscriber. Another descendant, Redbox, by 2009, also began to move into the market. Redbox kiosks were popping up in more locations across the country. Redbox offered new-releases at \$1 a DVD, compared to Flexplay's dated titles at \$5 to \$7 a DVD.²⁸ In a 2008 commercial for Flexplay, the spokeswoman declares, "Think of it like having DVDs on demand!"²⁹ Flexplay may not have achieved that goal, but it is successes and

²⁸ Sarah N. Lynch, "This DVD Will Self-Destruct," *Time.com*, July 1, 2008, <http://content.time.com/time/business/article/0,8599,1817828,00.html>

²⁹ Flexplay08, "Flexplay Commercial"

failures led to the technologies that now provide viewers all over the world unlimited streaming and viewing opportunities at any moment.

Annotated Bibliography

Barrett, Brian, "The 50 Worst Gadgets of the Decade,"
Gizmodo.com.au, December 24,
2009, <https://www.gizmodo.com.au/2009/12/the-50-worst-gadgets-of-the-decade/>

This is a list of the 50 worst technology-focused gadgets that were created in the 2000s. The list provided me with more insight into the multitude of inventions coming out in the 2000s. It helped me put Flexplay into context.

Dandumont, Pierre, "DVD jetable : les DVD-D et FlexPlay,"
JournalDuLapin.com, June 4,
2015,
<https://www.journaldulapin.com/2015/04/06/a-terminer-dvd-jetable-les-dvd-d-et-flexplay/>

This is French blog that had the best image of what the Flexplay packaging looked like. Searching for quality images of Flexplay packaging and discs made me realize how few images there are of Flexplay-related content. In a broader context, you are never sure what will have sticking power and what will not in the industry, so if you like something, make sure to document it and save those documents.

"Disney Debuts Time-Limited DVDs," *NACSONline.com* via
web.archive.org, May 20, 2003,
<http://archive.li/1bev6>

This is an article that explained the relationship between Flexplay Technologies and Buena Vista Home Entertainment/Walt Disney in 2003 and 2004 during the limited-play optical disk "boom."

"DVDs - digital versatile disks - how they're made and how they work," *PCTechGuide.com*,

<https://www.pctechguide.com/dvd/dvds-digital-versatile-disks-how-theyre-made-and-how-they-work>

This was one of a few resources that explained the technical elements of Flexplay in simple terms. This tutorial was helpful, as it allowed me to grasp the general elements of how Flexplay worked and what made it different, and then dive into the patent cases, that were very tough to read without any prior knowledge.

Flexplay08, "Flexplay Commercial," *YouTube.com*, August 1, 2008, www.youtube.com/watch?v=kXGxUjWiPQI.

This is a commercial for Flexplay. While it does not contain really any new information outside of what I already learned from other sources, I found the "save gas, use Flexplay" spin to be interesting.

"Flexplay (2003—2009)," *Museum of Obsolete Media*, <http://www.obsoletemedia.org/flexplay/>

I love this website. It was the first place I went to start my research. The "Flexplay" page gave me four links to visit related to Flexplay and really helped me get started digging deeper into the format.

Flexplay Technologies, Inc. 2003. Directory read inhibitor for optical storage media. US

Patent 6,641,886, filed June 29, 2000, and issued November 4, 2003. <http://patft.uspto.gov/netacgi/nph-Parser?u=%2Fnethtml%2Fsrchnum.htm&Sect1=PTO1&Sect2=HITOFF&p=1&r=1&l=50&f=G&d=PALL&s1=6641886.PN.&OS=PN/6641886&RS=PN/6641886>

This is one of three patents that I expressly quoted and used in my paper. This patent was one of the earlier ones to be submitted. In it, you can see Flexplay Technologies working through their many ideas for the format and brainstorming about all the very small minute changes that could be made.

Flexplay Technologies, Inc. 2004. Hermetically sealed package for optical media disk. US

Patent 6,678,239, filed January 25, 2002, and issued January 13, 2004. <http://patft.uspto.gov/netacgi/nph-Parser?u=%2Fnethtml%2Fsrchnum.htm&Sect1=PTO1&Sect2=HITOFF&p=1&r=1&l=50&f=G&d=PALL&s1=6678239.PN.&OS=PN/6678239&RS=PN/6678239>

This is the second of the three patents I expressly used in the paper. This patent has to do with the vacuum-sealed packaging that the discs come in. It was all super technical, but I enjoyed reading about the different methods Flexplay Technologies was toying with to block out

oxygen. I also liked see the progression from so many different ideas about how to partially block one layer of the disc, to seeing the choices narrowed down to oxidation.

Flexplay Technologies, Inc. 2005. Method for rendering surface layer of limited play disk

lightfast. US Patent 7,374,804, filed August 23, 2005, and issued May 20, 2008. <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetathtml%2FPTO%2Fsearch-adv.htm&r=42&f=G&l=50&d=PTXT&s1=Flexplay&p=1&OS=Flexplay&RS=Flexplay>

This was the third patent I specifically used in the paper, and it was by far my favorite one to read. Once I had a good grasp on the technology, I was able to, slowly, read through the patent and actually understand what Flexplay Technologies was trying to do when they wanted to make the first layer of the disc completely able to block out light. Who knew patents could be kind of like a scavenger hunt?

Harris, Tom, "How Flexplay DVDs Work," *HowStuffWorks.com*, <https://electronics.howstuffworks.com/flexplay2.htm>

This was another of the articles/how-tos that was incredibly helpful breaking down Flexplay discs and DVDs. When more technical words were used, the article would also explain what those words meant.

"Leuco dye," *Revolvy.com*, <https://www.revolvy.com/page/Leuco-dye>

This is an article about Leuco dye. It was one of the only articles I could find that did not try and dive completely into all of the chemical structures and the molecular level. I found it really helpful.

Lynch, Sarah N., "This DVD Will Self-Destruct," *Time.com*, July 1, 2008,

<http://content.time.com/time/business/article/0,8599,1817828,00.html>

This was just a fun article written right near the end of Flexplay's time in the industry. I enjoyed reading news from when the format was actually in use and was considered possibly useful.

nooruddeenzangi, "How Flexplay DVDs Work," *ATmega32-AVR.com*, September 19, 2013.

<https://atmega32-avr.com/how-flexplay-dvds-work/>

This was another of the simple terms articles that made reading the patents much more smooth sailing. It had a lot of overlap with the *HowStuffWorks.com* article, probably because they are basically the same site, except for a few more bothersome ads were present on this site.

OddityArchive, "Oddity Archive: Episode 99 - Disposable DVD's (DIVX & Flexplay),"

Youtube.com, April 14, 2016,
<https://www.youtube.com/watch?v=V3KIqgLIrsE>

The more chemical and technical parts of Flexplay can be challenging to understand when only reading about them. This video provided images of Flexplay discs and I was able to see how quickly a disc deteriorates once it is taken out of the vacuum-sealed package.

Snazzy Labs, "The Self-Destructing DVD That Failed: Retro Review of FlexPlay,"

Youtube.com, January 29, 2015,
https://www.youtube.com/watch?v=DLYSWC6_HU8

This was a very interesting video, as the host played a Flexplay disc that had been previously opened more than 48 hours earlier. The disc still played, however, it stopped about 80 minutes into the film, the screen went blank, and then the disc started skipping between time-codes. The video made me think more about whether each Flexplay disc was made with the same amount of polymer rosin and leuco dye or whether the engineering of the discs was imprecise at times.

Steele, Chandra, "Great Moments in 'Self-Destructing' Tech,"

PCMag.com, February 27,
2014, <https://www.pcmag.com/feature/321177/great-moments-in-self-destructing-tech>

This website offered the only image I could find of Flexplay.com. The image of the website home page is useful to examine and understand the organization of the product

and the company. The website homepage looks very organized, inviting, and easy to navigate.

Tynan, Dan, "The 25 Worst Tech Products of All Time,"
PCWorld.com, May 26, 2006.

https://www.pcworld.com/article/125772/worst_products_ever.html

This article briefly discussed the failure of DIVX. I thought it was a nice balance to the article about Flexplay's placement on the 50 Worst Gadgets of the Century list.

Weynand, Diana, and Vance Piccin. *How Video Works: From Broadcast to the Cloud*. 3rd ed.

New York: Focal Press, 2016. 276-282.

This textbook was incredibly helpful. I used it to help me, first, understand optical discs and DVDs, and second, explain those two elements in the paper.

"Winners: 2004 Technology Application Award,"

InnovisionAward.org via *web.archive.org*,

<http://archive.li/mERv9>

This was the sweetest news piece about Sealed Air Corporation and the work they did for Flexplay Technologies, creating the "cryovac oxygen scavenging systems" to keep the Flexplay discs away from oxygen. There was a quote that I could not find the right place for, so I will put it here: "This new information medium helps to

bring entertainment to movie buffs without concern for video store late fees or storage issues." I enjoyed how wholesome the company appeared.