The Unseen Failure: A Scientific Analysis of Ointment Degradation by Heat Stress

Introduction: The Fragility of a Precisely Engineered Medicine

Witnessing an over-the-counter ointment, which was instructed to be stored below 25°C, melt into a liquid-like state under the hot sun is a profoundly insightful observation. This is because it signifies more than a simple physical change; it represents a catastrophic failure of a complex and precisely engineered Drug Delivery System. Your question delves into the scientific basis of the storage instructions on drug labels, moving beyond a mere warning to a deeper intellectual curiosity about the consequences of non-compliance.

The purpose of this report is to dissect the cascade of events that occurs at a molecular level inside an ointment exposed to high temperatures and to establish a clear scientific rationale for why the product must be discarded. This report will systematically guide you from the basic structure of an ointment, through the chain reaction of heat-induced degradation, the three key risks of lost efficacy, toxicity, and infection, and finally, to environmentally responsible disposal methods. Through this, consumers will be equipped with the in-depth knowledge necessary to manage their medications more safely and responsibly.

Chapter 1: The Anatomy of a Topical Ointment: A State of Controlled Instability

To understand how an ointment fails, one must first have a fundamental scientific understanding of what an ointment is. An ointment is not simply a mixture of an active ingredient and oil; it is a highly engineered product designed for a specific purpose.

1.1. Core Components: Active Pharmaceutical Ingredient (API) and Excipients

An ointment is broadly composed of two parts: the active ingredient that produces the therapeutic effect, and the base that carries it.

- **Active Pharmaceutical Ingredient (API):** This is the molecule that performs the actual therapeutic action, such as an antibiotic, steroid, or antifungal agent. It is the "cargo" responsible for the core medicinal effect of the ointment.[1]
- **Excipient Matrix (Base):** The base is not merely a passive container for the API. Its role is highly complex and active. The base is a system composed of various excipients, designed to perform the following key functions:
    - To stably protect the API from chemical decomposition.
    - To precisely control the rate and amount of the API released onto the skin.
    - To provide desirable physical properties, such as a pleasant texture and spreadability for the user.
    - In multi-use products, to include preservatives to prevent microbial growth.[4]

While the user's interest is primarily in the effect of the API, the failure of an ointment most often begins in this excipient matrix. The structural and chemical integrity of the base is an essential prerequisite for ensuring the safety and efficacy of the API.

1.2. The Science of Emulsion: The Forced Cooperation of Oil and Water

Most ointments and creams are in the form of an 'emulsion.' An emulsion is a state where two immiscible liquids, like oil and water, are forcibly mixed to create a stable mixture. This is achieved through the use of a special substance called an emulsifying agent and a high-energy manufacturing process.[6]

An emulsion is inherently in a **thermodynamically unstable** state.[6] According to the laws of nature, oil and water tend to separate to minimize their contact area. Therefore, an ointment formulation is like a sophisticated barrier built to resist this natural tendency for separation.

More specifically, emulsions are classified as oil-in-water (O/W), where oil droplets are dispersed in water, and water-in-oil (W/O), where water droplets are dispersed in oil.

The solubility of the API (whether it dissolves better in oil or water) determines in which of these two phases it will be located. This detail is crucial for understanding why uniform dosage becomes impossible when an ointment separates.

With this background, we can understand ointments through the paradigm of 'controlled instability.' Emulsions are inherently unstable and tend to revert to a stable, separated state.[6] Manufacturers use high-energy processes to artificially create this unstable state.[6] This means an ointment is not a static substance like a rock, but a delicate system in a state of continuous, controlled tension. The storage temperature specified on the product label is the key parameter that maintains this control. Exceeding the prescribed temperature is like removing a key support from a bridge. The inherent instability is unleashed, leading to system collapse—that is, separation. This perspective redefines an ointment not as a simple mixture but as a delicate engineered system, clarifying why its failure is so critical.

Chapter 2: The Cascade of Failure: What Happens Under the Hot Sun

This chapter directly answers your first question, providing a detailed analysis of the physical and chemical degradation mechanisms that occur in an ointment exposed to high temperatures.

2.1. Physical Degradation: The Reality of "Melting," Irreversible Emulsion Breaking

The phenomenon you observed as "melted like a liquid" is not simple melting. It is a phenomenon called **phase separation**, or **emulsion breaking**.[6]

The mechanism is as follows: The intense heat energy from the sun rapidly increases the kinetic energy of the oil and water molecules. When this energy overwhelms the stabilizing force provided by the emulsifier, the emulsion structure begins to collapse.

- **Coalescence:** The dispersed fine liquid droplets (e.g., oil droplets in water) merge to form larger droplets.[6]
- **Creaming and Breaking:** The larger liquid droplets, due to density differences,

either rise to the top (creaming) or sink to the bottom. If this process continues, the oil and water eventually separate into two distinct layers (breaking).[6]

The most important point here is that this process is **irreversible**. Simply cooling the ointment tube will never return it to its original, finely and uniformly dispersed emulsion state. The precisely engineered structure is permanently lost. The phenomenon of water coming out before the ointment when squeezing a tube that was stored in the refrigerator is also a clear sign that phase separation and degradation have occurred.[5] This is the first reason, from a physical perspective, why a melted ointment cannot be reused.

2.2. Chemical Degradation: The Silent Destruction of Molecules

Behind the visible physical changes, invisible chemical reactions are accelerated by heat (thermolysis) and sunlight (photolysis).

- **Hydrolysis:** The now-free and abundant water molecules from phase separation can attack and break down the chemical structure of the API or excipients. This is a particularly significant problem for moisture-sensitive drugs like certain antibiotics (e.g., amoxicillin), drastically reducing their efficacy.[7]
- **Oxidation:** Heat and light can trigger reactions with oxygen, destroying the API and causing the oils or fats in the base to go rancid. This process can produce foul odors and new byproducts that may irritate the skin.[8]
- **Photolysis:** The ultraviolet (UV) radiation in direct sunlight can directly break chemical bonds, inactivating the API. This is precisely why many ointments are packaged in opaque containers or boxes and require 'storage protected from light'.[9]

Here, we must recognize the important fact of 'unseen danger.' While you witnessed the physical melting, research points to invisible efficacy loss and chemical decomposition.[7] This implies a very important public health message: even if an ointment has been exposed to high temperatures but has not

visibly separated, serious *chemical* degradation may have already occurred. The absence of a visible change does not guarantee safety or efficacy. Visible failure is a clear warning, but unseen failure is a hidden trap.

2.3. The Regulatory Context: Why "Store Below 25°C" is a Command, Not a Suggestion

Temperature guidelines like "Store below 25°C" on a product label are not mere recommendations. They are legal and scientific commands derived from rigorous **stability testing** mandated by regulatory agencies such as the Korean Ministry of Food and Drug Safety.[13]

Manufacturers must scientifically prove that their product remains safe and effective throughout its shelf life under the specified storage conditions. The accelerated testing conditions specified in stability testing regulations (e.g., 40±2°C / 75±5% relative humidity) are used to simulate short-term temperature fluctuations that may occur during long-term storage and distribution.[13] However, exposing a product to extreme environments that far exceed these testing conditions, such as inside a car parked in the summer sun (where temperatures can exceed 70°C [11]), completely invalidates all of the manufacturer's safety and efficacy guarantees.

Research materials may mention 'room temperature' and 'ambient temperature' with slightly different definitions, which can be confusing. It is important to clarify the official temperature definitions based on the Korean Pharmacopoeia.

Table 1: Official Definitions for Drug Storage Temperatures (Korean Pharmacopoeia Standard)

Term (Korean/English)	Temperature Range (°C)	Source/Note
Standard Temperature	20	[16]
Ambient/Normal Temperature	15 ~ 25	[10]
Room Temperature	1 ~ 30	[10]
Tepid/Luke-warm	30 ~ 40	[16]
Cool Place	1 ~ 15	[16] (Unless otherwise specified)

Refrigerated	2 ~ 8	[9] (For typical refrigerated drugs)
Frozen	-20 ± 5	[13] (For frozen drugs)

While this table shows general term definitions, the most important thing is the specific temperature stated on the individual product label (e.g., "Store below 25°C"). This is the final, legally binding instruction for that product.

Chapter 3: The Three Core Risks: Why Reuse is Medically Unacceptable

This chapter answers your second question by comprehensively analyzing why the reuse of a degraded ointment must be absolutely prohibited, focusing on the three core risks: 'efficacy,' 'safety,' and 'infection.'

3.1. The Efficacy Risk: A Medicine That No Longer Treats

- **Non-uniform Dosing:** Due to irreversible phase separation, the composition of the contents squeezed out of the tube will vary each time. Sometimes, you might get only an oily base with almost no API, and other times, you might get a highly concentrated clump of API that could potentially cause irritation. This makes it impossible to deliver the intended, precise dose to the skin.[5]
- **Loss of Potency:** The chemical decomposition of the API means the active ingredient itself no longer exists in an effective form. Simply put, the drug no longer works.[4] A study showing that nitroglycerin, a treatment for angina, lost almost all its effect after being kept in a pocket during the summer for 15 days is a powerful real-world example of how severe the loss of potency can be for drugs left in high temperatures.[10]

3.2. The Safety Risk: When a Treatment Turns into a Toxin

- **Formation of Irritants:** The substances created from the breakdown of the API or excipients are new chemicals not present in the original product. These are unverified and can cause severe skin irritation or allergic reactions, leading to new conditions like **contact dermatitis**.[22] A real case of a patient diagnosed with contact dermatitis after using an old, degraded ointment serves as a clear warning of the dangers of using such products.[23] In other words, using a heat-damaged ointment can create a new medical problem more severe than the one it was intended to treat.
- **Increased Systemic Absorption:** When the precisely engineered base matrix is destroyed, the permeability of the skin can change. This could result in excessive absorption of the API or its toxic degradation products into the bloodstream, which is a risk for serious systemic side effects, especially with potent drugs like steroids.[1]

3.3. The Infection Risk: A Product Turned into a Petri Dish

- **Collapse of the Preservative System:** Multi-use topical products are legally required to contain preservatives to prevent microbial contamination. High temperatures can break down these preservatives, rendering them ineffective.
- **Optimal Environment for Bacterial Growth:** The separated aqueous phase, now lacking effective preservation and rich in nutrients from degraded excipients, becomes an ideal environment—a petri dish—for bacteria and fungi to grow.[1]
- **Inducing Secondary Infections:** Applying such a contaminated product to broken or inflamed skin (the very reason for using an ointment) can cause a dangerous **secondary infection**.[3] This creates a paradoxical situation where the treatment designed to heal a wound actually infects it.

These risks are closely intertwined. The initial physical failure (phase separation) directly enables the subsequent biological failure (microbial growth). Heat doesn't just 'spoil' the medicine; it dismantles its defense system (preservatives) and creates the perfect conditions for contamination (free water). This demonstrates a 'cascade failure model,' where one problem sequentially causes another, more dangerous one. Thus, physical, chemical, and microbiological perspectives all converge to comprehensively explain why a degraded product is absolutely unsuitable for reuse.

Chapter 4: From Vigilance to Disposal: A Practical Guide for Consumers

This chapter provides practical, actionable steps for you to manage medications safely.

4.1. Identifying a Degraded Product: Obvious and Hidden Signs

There are several visual and olfactory clues that can suggest degradation:

- **Phase Separation:** An oily liquid or water separates from the solid base.[5]
- **Discoloration:** Any change from the original color.[4]
- **Texture Change:** Becoming gritty like sand, hardening, or becoming excessively runny.
- **Odor Change:** A rancid smell or any other unusual odor.[25]

However, the most critical warning here is that the absence of these obvious signs does not mean the product is safe. As discussed in section 2.2, serious chemical decomposition and loss of efficacy can occur even before any noticeable changes appear.

4.2. The Absolute Rule: When in Doubt, Throw It Out

The conclusion is clear and non-negotiable. Any medication that has been exposed to conditions outside its prescribed storage requirements, such as being left in a hot car or in direct sunlight, should be considered degraded and unsafe. The monetary cost of replacing the product is negligible compared to the potential health risks of using a degraded one.

4.3. The Final Step: Responsible Drug Disposal (Waste Medicine Management)

Degraded ointments should not be thrown in the regular trash or down the drain. This is because components like antibiotics can contaminate soil and water, causing environmental problems and threatening public health.[29] Waste medicines are classified as 'household hazardous waste' and require special handling.

The following guidelines are provided for you to dispose of degraded medicines safely and correctly.

Table 2: Guide to Safe Segregated Disposal of Household Waste Medicines (South Korea Standard)

Medicine Type	Preparation	Disposal Method	Disposal Location
Ointment/Cream	Remove only the outer paper box.	Do not squeeze out the contents. Dispose of the tube as is with the cap tightly closed.[30]	Waste medicine collection boxes at pharmacies, public health centers, and community service centers.
Pills (PTP Pack)	Remove only the outer paper box.	No need to separate pills from the packaging. Dispose of the PTP sheet as is.[32]	Collection boxes at pharmacies, public health centers, community centers. Mailbox disposal available in some areas (e.g., Seoul).[31]
Pills (Bottle)	Remove only the outer paper box.	Collect only the pills in a plastic bag and dispose.[30]	Collection boxes at pharmacies, public health centers, community centers. Mailbox disposal available in some areas (e.g., Seoul).[31]
Powdered Medicine	Separate and discard the paper pouch with personal information	To prevent powder from scattering, dispose of the	Collection boxes at pharmacies, public health centers,

	as general waste.	packets unopened.[30]	community centers. Mailbox disposal available in some areas (e.g., Seoul).[31]
Liquid/Syrup	Remove only the outer paper box.	Collect the remaining liquids into one bottle, seal the cap tightly to prevent leaks, and dispose.[30]	Collection boxes at pharmacies, public health centers, community centers. **Mailbox disposal is not permitted**.[31]

The mailbox collection system recently implemented by some local governments is very convenient, but it's important to check your local guidelines before disposal, as liquids and ointments are often excluded due to the risk of breakage and leakage.[31]

Conclusion: The Path to Respecting Science and Ensuring Safety

Through this analysis, it has become clear that an over-the-counter ointment is not a simple mixture but a complex, precisely controlled emulsion system. High temperatures and direct sunlight shatter this delicate balance, simultaneously causing irreversible physical collapse (phase separation) and silent chemical decomposition.

Consequently, reusing a degraded ointment is an act of exposing oneself to the 'three core risks' of lost efficacy, skin damage from unpredictable toxic substances, and serious secondary infections. The storage instructions on a medication label are an absolute command, reflecting the scientifically determined limits of the product's stability and safety.

Your critical thinking and careful attitude in raising a question fundamental to patient safety are essential for all medication management. Respecting the scientific principles of pharmaceuticals and following the correct storage and disposal guidelines is the surest way to protect our own health and that of our community.

참고 자료

1. 넘어지면 그냥 연고 바른다고요? 항생제 내성 생겨요 - 중앙일보헬스미디어, 7월 31, 2025에 액세스, https://jhealthmediam.joins.com/article/article_view.asp?pno=18553

2. 상처가 나면 어떤 연고가 가장 효과적일까?-성분별로 완벽하게 선택하는 방법 - YouTube, 7월 31, 2025에 액세스, https://www.youtube.com/watch?v=HEcGgAiVeUA
3. 조금만 다쳐도 바로 연고 바르는 분들, 꼭 보세요 - 헬스조선, 7월 31, 2025에 액세스, https://m.health.chosun.com/svc/news_view.html?contid=2024012602193
4. [복약상식] 상온 보관이 기본 ... 냉장보관은 응결·물리적 성질 변화로 약효 감소 우려, 7월 31, 2025에 액세스, http://www.healtho.co.kr/news/view.php?idx=93135
5. 언제 개봉했는지 기억도 안 나는 가글·연고, 그냥 썼다간... - 헬스조선, 7월 31, 2025에 액세스, https://m.health.chosun.com/svc/news_view.html?contid=2023102701913
6. KR102368646B1 - 상온 유화 공정을 이용한 아토피 개선 로션 ..., 7월 31, 2025에 액세스, https://patents.google.com/patent/KR102368646B1/ko
7. [데일리팜] 여름철 약배달 실험해보니...고온다습 약효저하 우려, 7월 31, 2025에 액세스, https://m.dailypharm.com/News/304513
8. 약을 상온에 보관한 경우 효과에 영향을 미칠까요? - 닥터나우, 7월 31, 2025에 액세스, https://doctornow.co.kr/content/qna/391fa82746434240ae8d52f6e874c179
9. 의약품 상온보관 온도 15~25℃...폭염 속 주의 필요 - 히트뉴스, 7월 31, 2025에 액세스, http://www.hitnews.co.kr/news/articleView.html?idxno=1721
10. 폭염은 약 효력도 떨어뜨린다 - 한국일보, 7월 31, 2025에 액세스, https://www.hankookilbo.com/News/Read/201808020900358110
11. “바르는 약은 실온에...냉장 보관 시 지퍼백에 넣어야” - 대구신문, 7월 31, 2025에 액세스, https://www.idaegu.co.kr/news/articleView.html?idxno=255838
12. 피부 연고는 실온에 보관해야 안전... 아스피린은? - 헬스조선, 7월 31, 2025에 액세스, https://m.health.chosun.com/svc/news_view.html?contid=2018080201787
13. 현행행정규칙 > 규칙명 > 의약품등의 안정성시험 기준 | 국가법령정보 ..., 7월 31, 2025에 액세스, https://www.law.go.kr/admRulSc.do?menuId=5&subMenuId=41&tabMenuId=183&query=%EC%9D%98%EC%95%BD%ED%92%88%EB%93%B1%EC%9D%98%20%EC%95%88%EC%A0%95%EC%84%B1%EC%8B%9C%ED%97%98%20%EA%B8%B0%EC%A4%80
14. 행정규칙 > 의약품등의 안정성시험 기준 - 국가법령정보센터, 7월 31, 2025에 액세스, https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2000000020724
15. www.law.go.kr, 7월 31, 2025에 액세스, https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2000000020724#:~:text=%EC%8B%A4%EC%98%A8%EB%B3%B4%EA%B4%80%EC%9D%98%EC%95%BD%ED%92%88%20%3A%2040%C2%B1.%EC%8A%B5%EB%8F%84%2025%25%EC%9D%B4%ED%95%98%EB%A1%9C%20%ED%95%9C%EB%8B%A4.
16. 현실 외면 의약품보관온도규정-'왜 도매상만' - 약업신문, 7월 31, 2025에 액세스, http://m.yakup.com/news/index.html?nid=93604&mode=view
17. 대한약전 통칙 16항(표준온도, USP표준온도, 상온, 실온, 미온, 냉소, 냉수, 미온탕, 온탕, 열탕, 열용매, 온용매, 수욕에서 가열, 냉침, 온침, 열 에탄올, 온 에탄올) - 분석화학실험노트, 7월 31, 2025에 액세스, https://qcqanote.tistory.com/entry/%EB%8C%80%ED%95%9C%EC%95%BD%EC%A0%84-%ED%86%B5%EC%B9%99-16%ED%95%AD%ED%91%9C%EC%A4%80

%EC%98%A8%EB%8F%84-USP%ED%91%9C%EC%A4%80%EC%98%A8%EB%8F%84-%EC%83%81%EC%98%A8-%EC%8B%A4%EC%98%A8-%EB%AF%B8%EC%98%A8-%EB%83%89%EC%86%8C-%EB%83%89%EC%88%98-%EB%AF%B8%EC%98%A8%ED%83%95-%EC%98%A8%ED%83%95-%EC%97%B4%ED%83%95-%EC%97%B4%EC%9A%A9%EB%A7%A4-%EC%98%A8%EC%9A%A9%EB%A7%A4-%EC%88%98%EC%9A%95%EC%97%90%EC%84%9C-%EA%B0%80%EC%97%B4-%EB%83%89%EC%B9%A8-%EC%98%A8%EC%B9%A8-%EC%97%B4-%EC%97%90%ED%83%84%EC%98%AC-%EC%98%A8-%EC%97%90%ED%83%84%EC%98%AC

18. www.yakup.com, 7월 31, 2025에 액세스, https://www.yakup.com/news/news_print.html?nid=90715#:~:text=%ED%95%9C%ED%8E%B8%20%EB%8C%80%ED%95%9C%EC%95%BD%EC%A0%84%20%ED%86%B5%EC%B9%99%2015.%E2%84%83%EC%9D%B4%ED%95%98%EB%A5%BC%20%EB%9C%BB%ED%95%9C%EB%8B%A4.
19. 상온과 실온의 차이 - 호기심과학 - Daum 카페, 7월 31, 2025에 액세스, https://cafe.daum.net/bhos3/EdvK/84?q=D__-pOH43jX7o0&
20. 연고를 냉장보관하지 못할 때, 보관은 필요한가요? - 닥터나우, 7월 31, 2025에 액세스, https://doctornow.co.kr/content/qna/c683588189ea4078a5ca03ad201400ae
21. 피부외용제] 후시딘 - 동화약품, 7월 31, 2025에 액세스, https://www.dong-wha.co.kr/product/content.asp?t_idx=85
22. 항진균제 연고 사용시 부작용은 무엇인가요? - 닥터나우, 7월 31, 2025에 액세스, https://doctornow.co.kr/content/qna/2717dd0417644bbca0bcff6c7d144fed
23. 개봉한 지 6개월 지난 연고 약효 떨어지고 피부염 유발 - 헬스조선, 7월 31, 2025에 액세스, https://m.health.chosun.com/svc/news_view.html?contid=2013060402248
24. 언론속의 벧엘피부과 - 변질된 화장품으로 피부트러블~ 주의점은? - 조선일보, 7월 31, 2025에 액세스, http://www.bethelskin.com/593
25. [배현 약사의 약 부작용 이야기] 믿었던 연고의 배신? “발랐더니 더 가려워요” - 헬스경향, 7월 31, 2025에 액세스, https://www.k-health.com/news/articleView.html?idxno=42667
26. 약도 더우면 변질 됩니다...알아두면 좋은 꿀팁 - 비즈워치, 7월 31, 2025에 액세스, http://news.bizwatch.co.kr/article/consumer/2023/08/11/0029
27. 많고 많은 연고...어디에, 어떻게 발라야 하죠? - 헬스경향, 7월 31, 2025에 액세스, https://www.k-health.com/news/articleView.html?idxno=31339
28. [라이프] "연고가 왜 이렇게 미끈거리지"...폭염에 변질되는 의약품, 그냥 두면 효능도 떨어진다?, 7월 31, 2025에 액세스, https://news.sbs.co.kr/news/endPage.do?news_id=N1004876236
29. www.songpa.go.kr, 7월 31, 2025에 액세스, https://www.songpa.go.kr/ehealth/selectBbsNttView.do?nttNo=19240469&pageUnit=10&bbsNo=179&key=4713&pageIndex=1#:~:text=%ED%8F%90%EC%9D%98%EC%95%BD%ED%92%88%EC%9D%80%20%EC%8B%9C%EB%AF%BC%EC%9D%98,%E2%80%9C%EC%83%9D%ED%99%9C%EA%B3%84%20%EC%9C%A0%ED%95%B4%ED%8F%90%EA%B8%B0%EB%AC%BC%E2%80%9D%EC%9E%85%EB%8B%88%EB%8B%A4.&text=%EA%B0%80%EA%B9%8C%EC%9A%B4%20%EB%8F%99%EC%A3%BC%EB%AF%BC%EC%84%BC%ED%84%B0%20%ED%8F%9

0%EC%9D%98%EC%95%BD%ED%92%88%20%EC%88%98%EA%B1%B0%ED%95%A8%EC%97%90%20%ED%8F%90%EA%B8%B0%ED%95%B4%EC%A3%BC%EC%84%B8%EC%9A%94.
30. 약/폐의약품처리 - 나무위키, 7월 31, 2025에 액세스, https://namu.wiki/w/%EC%95%BD/%ED%8F%90%EC%9D%98%EC%95%BD%ED%92%88%EC%B2%98%EB%A6%AC
31. 유효기간 지난 감기약, 밀봉해서 가까운 우체통에 배출하면 끝! | 서울시, 7월 31, 2025에 액세스, https://mediahub.seoul.go.kr/archives/2009909
32. [폐의약품] 남은 약을 버리는 올바른 방법 - YouTube, 7월 31, 2025에 액세스, https://www.youtube.com/watch?v=y0fFI-aAzDg
33. 유통기한 지난 약 어떻게 할까?...“우체통에 넣으세요” - 서울경제, 7월 31, 2025에 액세스, https://www.sedaily.com/NewsView/29SBYQ6PUG
34. [띵동정보통] 유효기간이 지난 폐의약품 어떻게 버려야 할까요? - YouTube, 7월 31, 2025에 액세스, https://m.youtube.com/shorts/04-LymkNkHA
35. 먹다 남은 약, 어디다 버릴까? 쓰레기통 말고 우체통에 넣어 주세요 / KBS 2024.07.19., 7월 31, 2025에 액세스, https://www.youtube.com/watch?v=LI9G3UGAb6k