LA-UR-15-26595

Title: Characterization of the Potential Hazards Associated with Potential RCRA Treatment Noncompliances

Author(s): Clark, David Lewis

Intended for: NMED deliverable

Issued: 2015-08-20

Los Alamos
NATIONAL LABORATORY
EST. 1943

Characterization of the Potential Hazards Associated with Potential RCRA Treatment Non-compliances Report

Prepared by:

David J. Funk ______________________

Deputy Associate Director, Environmental Programs

David L. Clark ______________________

Program Director, National Security Education Center

Reviewed by:

John E. Marra, Ph.D. ______________________ 8/13/15

Senior Technical Advisor, US DOE, Office of Environmental Management

Approved by:

Randall Erickson ______________________ 8/14/15

Associate Director, Environmental Programs

Subject: Characterization of the Potential Hazards Associated with Potential RCRA Treatment Noncompliances

David J. Funk and David L. Clark

In response to the WIPP incident, Los Alamos National Laboratory conducted an Extent of Condition (EOC) review of waste processes to identify whether additional potential noncompliances (beyond those previously identified with remediated nitrate salts) under the LANL Resource Conservation and Recovery Act (RCRA) Permit were made. This comprehensive review determines the extent of treatment noncompliances and serves as a lesson for future remediation work and workers going forward, so as to meet our commitments with the State of New Mexico in a safe and compliant fashion.

The purpose of this document is to provide a hazard evaluation of the noncompliances and whether any new actions are required to mitigate potential risk to the worker or the public. ***In short, we have reviewed the noncompliances and have concluded that the possibility of exothermic reactions leading to radioactive release is not credible, and in one case, inconceivable, stemming from the fact that the majority fraction of the waste is compatible with organic absorbents and neutralizers. It is not expected that the noncompliances would generate or produce uncontrolled flammable fumes, gases, extreme heat, pressure, fire, explosions, or violent reactions***. Regarding nuclear safety basis, where consequence should also be considered, we expect there to be a low consequence to the worker or the public: a container breach is not expected due to the small quantities of potentially incompatible materials identified.

We provide a brief summary of the EOC review below, and then discuss the waste streams and the potential for hazards that each waste stream could present.

Overview of the Extent Of Condition (EOC) Review

The instances of noncompliance involve the processing of four mixed transuranic (mixed TRU or MTRU) waste streams (other than nitrate salt-bearing waste) at LANL: oversized box debris waste (LA-MHDxx), drummed debris waste (LA-MHDxx), wastewater treatment sludges (LA-MINxx), and cemented waste (LA-CINxx)[1]. The purpose of the EOC review was to determine whether LANL's prior remediation activities associated with TRU/MTRU waste streams other than nitrate salts had compliance issues similar to the nitrate salts remediation activities. LANL wanted to determine whether:

(1) the same flaws identified in the nitrate salts remediation procedures may have affected TRU/MTRU waste streams other than the unconsolidated nitrate salts; and

[1] The "xx" indicates that each of these CCP-AK waste streams includes containers in several sub-waste-streams.

(2) said flaws may have affected LANL locations that processed waste in addition to the Waste Characterization, Reduction, and Repackaging Facility (WCRRF) facility (i.e., locations at Technical Area (TA)-54, Area G).

"Remediated" MTRU waste is defined as LANL MTRU waste (from "parent" containers) that was processed to remove liquids through the addition of absorbent material (e.g., kitty litter and/or polymer sorbents) – in some cases, with the addition of neutralizers - and repackaged into new drums or waste boxes (called "daughter" containers). The remediation process was necessary to remove free liquids from parent containers, in order to meet the WIPP Permit requirement that TRU waste containers received at WIPP may not contain free liquids greater than 1% volume of the waste (WIPP Permit, §2.3.3.1).

However, as with the nitrate salts, some remediation activities may have constituted impermissible treatment. EPA defines "treatment" to include "any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of the waste ... to render the waste non-hazardous, or less hazardous; safer to transport, store, or dispose..." Specifically, the EOC review focused on identifying whether:

(a) any absorption processes employed to remediate TRU or MTRU wastes may have constituted instances of impermissible treatment of hazardous waste;

(b) any neutralization processes employed to remediate TRU or MTRU wastes may have constituted instances of impermissible treatment of hazardous waste; and

(c) any instances occurred where potentially incompatible absorbents or neutralizers may have been mixed with the waste (potentially resulting in creation of a problematic secondary waste stream).

In review of these records, we identified three categories of noncompliances:

1. **Unpermitted treatment by absorption.** Principally, adding absorbent to the parent container, not to a daughter at the time of generation. In some cases absorbent was added after Real Time Radiography RTR showed liquids were still present, a violation of RCRA, which requires addition of absorbent at the time of generation.
2. **Unpermitted treatment by neutralization.** RCRA allows neutralization if, and only if, the D002 characterstic is applicable. If any other hazardous waste codes apply, then a permit is required to neutralize.
3. **Mixing of Potentially Incompatible Absorbers and/or Neutralizers with the Waste.** RCRA forbids the mixing of incompatible materials to prevent potentially hazardous reactions.

In support of this review, LANL reviewed records for a targeted subset of a population of 9778 MTRU waste containers remediated at LANL between 2006[2] and 2014. This effort resulted in identifying 566 potential noncompliances (in a total of 508 containers, some with multiple noncompliances) as follows:

- 154 containers were remediated using absorption methods that potentially did not meet the RCRA permit exemption
- 58 containers were remediated using potentially impermissible neutralization methods
- 354 containers were considered potential noncompliances based on mixing potentially incompatible absorbents or neutralizers with the waste.

This document summarizes the potential incompatibilities and the possible hazards resulting from the mixing of potentially incompatible materials. We note that the EOC took a very conservative approach as to whether the addition was incompatible. As an example, we have included the analysis as to whether the addition of Swheat® would be considered incompatible, in Appendix A. Essentially, the absorbent/neutralizer used was compared with the known source of oxidizers identified in the Central Characterization Project (CCP) Acceptable Knowledge (AK) documents (CCP-AK-006, rev. 13 and CCP-AK-004, rev. 7). We note that WIPP has a no migration variance, and as a result, it can accept a very broad spectrum of waste, i.e. heavy metals, absorbed solvents, etc. An evaluation of such a broad waste stream (from organics to metals to oxidizers) will almost inevitably result in incompatibilities[3].

Evaluation of the Potential Hazards for Each Waste Stream

Inorganic Sludges (LA-MIN03-NC.001): 172 noncompliant containers

Waste stream LA-MIN03-NC.001 consists of homogeneous dewatered sludge generated during the treatment of caustic and acid waste streams through the addition of base. The main treatment process removed particulate and heavy metals as a sludge that settled out and/or was cleaned out of the clariflocculation tanks. The first step of the main treatment process was the addition of flocculants to produce a precipitate and involved addition of (primarily) calcium carbonate and ferric hydroxide. The precipitate or sludge was then dewatered and contained approximately 25 to 40 percent inorganic solids with a "wet clay" consistency. Perlite or diatomaceous earth was used after dewatering to further filter and absorb liquids present in the

[2] That year was chosen as the demarcation point at which LANS began absorption and neutralization activities on TRU waste.

[3] The AK describes a waste stream that is inherently incompatible with itself. Cf., the LA-MINHD01.001 debris waste stream table summarized on pages 96-105 in CCP-AK-LANL-006, Rev. 13.

sludge. Finally, Portland cement was added to the bottom and top of the sludge during packaging. Prior to remediation, this waste may also contain debris, including but not limited to containers (e.g., unpunctured aerosol cans, vials), metal, personal protective equipment (PPE), plastic, and secondary waste from repackaging.

Because the nitrate ion is stable and highly soluble it is not amenable to removal by conventional water treatment processes such as coagulation and precipitation. As a result, the sludge would not contain any significant concentration of nitrates (oxidizers). ***While the sludge is technically incompatible with organic neutralizers/sorbents, the potential for thermal runaway from these mixtures is not credible due to the fact that these low concentrations cannot lead to significant chemical reaction.***

TA-35 Heterogenous Waste: 1 noncompliant container (one drum)
This waste was generated from a TA-35-2-Wing C glove box in which the plastic glove box extension was bagged out into a 55 gallon drum and it has not been assigned to a CCP-LANL AK at this time, though it appears to fit in the MHDXX waste stream. Operators at WCRRF noted that the drum contained the following: gloves, kitty litter, plastic, fiberglass, wipe balls, cardboard. None of these components exhibit incompatibilities with organic neutralizers/sorbents. ***The possibility of any reaction from this drum would be inconceivable due to the compatibility of organic absorbents and neutralizers with this waste.***

Waste Stream LA-MIN02-V.001: 6 noncompliant containers

Waste stream LA-MIN02-V.001 consists primarily of inorganic particulate waste generated in TA-55. The waste is largely comprised of TRU waste such as liquids and solids absorbed or mixed with absorbent (e.g., Ascarite II, [sodium hydroxide coated silicate], diatomaceous earth [silica and quartz], kitty litter [clay], vermiculite [hydrated magnesium-aluminum-iron silicate], and/or zeolite [aluminosilicate mineral]), though a wide range of chemicals and other materials are included in the complete AK. For example, this is the waste stream that included the nitrate salts, i.e. those responsible for the WIPP incident. Since there were only six records associated with these noncompliances, we reviewed each record against the generator and operator comments listed below, and we find no incompatibilities:

Generator Record	Operator Comments
Solidified Organic	Metal cans, vermiculite, plastic, liquid
PD-241; kerosene (30% DBEP) vermiculite (70%) - Organics: Benzene, toluene, styrene, polystyrene fragments (decomposition from heating Polystyrene, contents is inhomogeneous)	Plastic, vermiculite, 5 gallon container

Organic liquids absorbed in vermiculite	Plastic, (2) 5 gallon buckets, solidified inorganic and organic solids
Pyrochemical salts in 5 gal pails; paint chips/stripper, cheesecloth in 5 gal buckets	Plastic, liquids, (2) 5 gallon buckets, solidified inorganic and organic solids.
Room trash assigned Code A60 (other combustible)	Poly liner lid, banding, but most of drum is like brown sand clay gravel mixed together. Kitty litter Hex armor gloves on last daughter.
Room trash assigned Code A60 (other combustible)	Poly liner lid, banding, but most of drum is like brown sand clay gravel mixed together. Kitty litter Hex armor gloves on last daughter.

LANL believes that MIN02 was assigned to this waste stream on the basis of the vermiculite or inorganic material (sand, clay, gravel) that was identified in the waste. We note that pyrochemical salts consist of sodium and potassium chloride and are compatible with organic sorbents/neutralizers. ***We find that the possibility of thermal runaway for these drums is not credible, since organic absorbents and neutralizers are compatible with the majority components of the waste.***

Boxline and Drum Debris Waste Stream MHD0X.0xx: 148 noncompliant containers

The typical AK for debris waste stream included a statement such as: the waste "consists primarily of mixed heterogeneous combustible and non combustible debris. Example of combustible materials include: paper, rags, plastic, rubber, wood-based high-efficiency particulate air (HEPA) filters...". In addition, the AK identified all of the potential chemicals that might be expected to be associated with this stream, and as noted previously, if taken literally, would be incompatible with itself.[3] The majority of these chemicals are minor or trace constituents and while technically incompatible, provide little or no means to support chemical reactions that could lead to any kind of runaway within a debris drum. Thus, the addition of other organics (e.g. Swheat) to absorb any liquid would not lead to an incompatibility of any significance.

A question arises as to where the liquids that were absorbed came from. Oversized TRU legacy waste was from cold war operations and was brought to Area G up to 30-40 years ago. This waste, which consisted of piping, filters, gloveboxes, tanks, equipment and pencil tanks, were packaged at the generator sites primarily in Fiber-Re-enforced Plywood (FRP) crates that were buried underground for many years, and then unearthed and placed into storage domes. Both the underground storage and placement in above ground sites that sometimes experienced leaks, allowing water to be captured within the debris waste form. In addition, residual liquid in bottles that were used to decontaminate during initial packaging were a second source of liquid. Third, many of the drums were power-washed when brought above grade and their condition would have potentially allowed water into the waste. In any event, given the nature of the waste stream (mixed combustible and noncombustible material) the Swheat or other organic absorbers/neutralizers would be technically incompatible but not present a source of chemical reactions. ***We conclude that the possibility of thermal runaway for these drums is not credible, since organic absorbents and neutralizers are compatible with the majority components of the waste.***

Cemented Inorganic Waste, LA-CIN01.001, Treated with Swheat Kitty Litter (Absorption of Liquids with Organic Absorbers): 180 noncompliant containers

Waste stream LA-CIN01.001 consists primarily of inorganic homogeneous solid waste (cemented TRU waste) generated within TA-55. Many waste products were encased within cement in this fashion. For the purposes of this discussion, we are referring to the subset of LA-CIN01.001 that was generated with evaporator liquids from TA-55 nitric acid plutonium recovery operations. These liquids were expected to be near saturation with nitrate salts (the salts were precipitated and the remaining liquid was used in the cementation process). This aqueous waste was immobilized in Portland or gypsum cement using processes that were not as robust as those of today. This waste stream was generated prior to 1991, and radiographic analysis of the waste stream often indicated liquids (dewatering) failing the WIPP WAC, and as a result, this waste stream required remediation prior to acceptance by WIPP.

Remediation was conducted within the Glove Box at WCRRF, and during the timeframe of interest, Swheat Kitty Litter was the absorbent used, both to remediate liquids, and based on operator interviews, often as a precaution against dewatering (even when liquid was ***not*** reported to be present).

The use of Swheat in this manner, when combined with nitrate salt solution, triggers a measure of concern: nitrates are incompatible with organics, and solutions of concentrated nitrates can be characterized as oxidizers (see below). However, the risks associated with the use of the organic absorbent in this manner are expected to be very different than the risks associated with the remediated nitrate salts (RNS):

- Quantities of absorbent used were only that required to absorb the small quantity of liquid present.
- The chemical environment of the liquid is expected to be alkaline (use of grout) versus strongly acidic for the nitrate salts, which would not support solution phase nitration of the Swheat.
- The concentration of nitrates in the free liquids is much lower than those of the neat nitrate salts, though they could be at oxidizer levels

(see below).

- NO_2/N_2O_4 will not be generated (salts are in solution), and the Swheat will not become nitrated through gas-phase reactions, in contrast to the Remediated Nitrate Salt (RNS) waste stream.
- The large volume of cement comprising the vast majority of the contents of the drum is inherently inert.
- No organic neutralizers were used with the free liquids.

Ultimately, the degree of hazard will depend on the concentration of the nitrate salts in solution, as well as their chemical makeup, resulting in their classification as Div. 5.1 Oxidizer in some instances (e.g., 45 wt.% sodium nitrate solution, Packing Group III) and ***not*** Div. 5.1 in other cases (e.g., saturated solution of calcium nitrate).[4] Liquid nitrates are tested using UN DOT O.2 testing, to determine their oxidizing potential and appropriate Packing Group for transportation.

To evaluate the potential hazard created by absorbing with Swheat, an understanding of the chemical environment of the liquid is required. To achieve that understanding, a campaign to sample free liquids from eight CIN01 drums was initiated. Chemical analysis from the first free liquid sample was recently completed, indicating nitrate salt concentrations that may be at "oxidizer levels" (approximately 34% by wt., cf. Appendix B). As a result, we will conduct UN DOT O.2 testing of non-radioactive surrogated to evaluate whether the liquid exhibits the D001 characteristic (45% sodium nitrate is a Packing Group III oxidizer, the least "oxidizing" of liquid oxidizers).

We do expect that the degree of hazard presented by this waste form to worker (and public) is very different from, and does not approach, the hazard presented by the RNS waste form. As indicated previously, the quantities, pH, salt concentration, lack of nitration, lack of organic neutralizer, and environment (large mass of inert cement), create an environment very different from the remediated nitrate salt drums. ***As a result of these differences, the possibility for thermal runaway of the Swheat used in the absorption process is not credible.***

To support this analysis, we developed the following strategy to understand the nature of the hazard as well as the degree of reactivity taking place within the CIN01 drums remediated with Swheat:

1. Differential Scanning Calorimetry (DSC) is a useful screen to

[4] Recommendations on the Transport of Dangerous Goods Manual of Tests and Critera, United Nations Publishing (New York and Geneva), Fifth Edition (2009).

evaluate thermal stability/sensitivity. We conducted tests on surrogates that included a known oxidizer, 45 wt.% sodium nitrate; and a solution prepared from our most thermally active salt surrogate WB8 as follows:

a. 45 wt.% solution of $NaNO_3$ mixed with Swheat in 1:1 and 3:1 ratios (by volume)

b. A saturated solution of WB8 also mixed with Swheat in 1:1 and 3:1 ratios (by volume)

c. Tests were conducted with both wet and dry surrogates. In all cases, reactions did not initiate until the mixture was over 100 °C, with an estimate of the most reactive occurring at 125 °C (cf. Appendix C).

2. We will conduct headspace gas analysis on the CIN01 drums. As noted in Clark and Funk (2015),[5] CO_2:H_2 ratios greater than 6.5 are indicative of processes other than radiolysis such as oxidation. Thus, ratios of less than 6.5 would likely be indicative of only radiolytic processes, leading to the conclusion that little chemistry is taking place within the CIN01 drum.

Furthermore, in our testing of nitrate salt/Swheat surrogates, we note that the material (pure salt mixed with Swheat), failed the UN DOT O.1 testing (solid oxidizer), but was on the edge of "passing" (would not have been considered an oxidizer). Our expectation is, that given the low concentration of salt relative to Swheat, that the material will likely test out as a D001 characteristic waste, and we will propose conducting these tests as part of our strategy to characterize these materials. *This testing will be conducted to support a regulatory determination of the characteristic of the waste and should not be construed as additional evaluation of the hazards of this waste form.* Thus, we will:

1. Conduct UN DOT O.1, Method 1030, and Method 1050 for the Swheat/absorbed liquid and O.2 testing for the neat liquid using surrogates, to properly evaluate this waste form for RCRA characteristic D001 (using external laboratories such as Southwest Research Institute; SWRI).

The tests and sampling are expected to take several weeks to complete. In addition, we expect to continue to sample the other seven CIN01 drums to ensure we have "representative" samples. Based on testing to date, we do not anticipate the need to include the CIN01 drums remediated with

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[5] Clark, D. L. and D. J. Funk, 2015. Chemical Reactivity and Recommended Remediation Strategy for Los Alamos Remediated Nitrate Salt (RNS) Wastes. LANL Report LA-UR-15-22393

Swheat (though we have examined this as an option) in the container isolation plan. ***Based on the discussion above and the testing completed to date, thermal runaway is not credible for the LA-CIN01.001 waste stream.***

Spontaneous combustion from Swheat self-heating

As noted in the Clark and Funk[5] report, the possibility of self-heating of Swheat has been considered as the potential initiator for the spontaneous combustion of Drum 68660, the drum responsible for the radiation release within Room 7 of Panel 7 at WIPP. In the cases identified above, the Swheat has been determined to be compatible with the majority fraction of the waste, and were any self-heating to occur, the reaction could not be sustained due to the lack of oxidizer that would be available. This is in contrast with the nitrate salt waste, where self-heating would be fed by the oxygen that would be released from the incompatible oxidizer, the nitrate salts themselves. ***The risk of spontaneous combustion leading to drum breach is not credible, a result of the fact that organic absorbents and neutralizers are compatible with the majority faction of the waste form.***

Conclusions

Utilizing a conservative approach to the noncompliances by comparing the use of organics (neutralizers/sorbents) with the CCP AK data for the waste streams, chemicals identified within the AK could potentially be present in the waste that, in pure form and/or sufficient concentrations, could be incompatible with organic neutralizers/sorbents (such as Swheat® or Kolorsafe®). ***However, a careful review of the waste stream, and understanding the majority components, we find that the possibility of thermal runaway for containers associated with these noncompliances is not credible, and in once case, inconceivable, stemming from the fact that the majority fraction of the waste is compatible with organic absorbents and neutralizers. It is not expected that the noncompliances would generate or produce uncontrolled flammable fumes, gases, extreme heat, pressure, fire, explosions, or violent reactions.*** Regarding nuclear safety basis, where consequence should also be considered, we expect there to be a low consequence to worker or public: a container breach is not expected due to the small quantities of potentially incompatible materials identified. As a an added measure of conservatism, LANL will conduct surrogate testing and Headspace Gas Sampling of the CIN01 waste stream, to support our conclusion that the levels of oxidizers contained within the CIN01 liquids to not support assigning the RCRA D001 characterstic to this waste stream.

APPENDIX A.

ANALYSIS OF CCP-AK-004 AND CCP-AK 006 WASTE STREAMS FOR POTENTIAL INCOMPATIBILITY WITH Swheat™ SORBENT

Four mixed transuranic (MTRU) waste streams were remediated by ADEP/LTP using organic sorbents and/or neutralizers between 2006 and 20014. The purposes of this analysis were as follows:

(1) to identify any chemicals that may have been present in four remediated waste streams that were potentially incompatible with organic sorbents (*the organic sorbent Swheat™ is the specific focus of this analysis*); and

(2) if so, to address the following question: were the chemicals likely to be present in forms or quantities sufficient to constitute an incompatibility of wastes and sorbents in the same container?

Permit Requirements

Permit Section 2.8 requires the Los Alamos National Laboratory (LANL) Permittees to "*...take precautions during the treatment or storage of ignitable or reactive waste, the mixing of incompatible waste, or the mixing of incompatible wastes and other materials to prevent reactions...*"

Permit Sections 2.4.1(3) and 2.4.1(4) require the LANL Permittees to "*...obtain and document all of the information that must be known to treat, store, or otherwise manage a hazardous waste stream in accordance with 40 CFR Parts 264 and 268 including... waste characterization necessary to prevent the mixing or placing of incompatible wastes in the same container*" and "*...waste characterization necessary to prevent accidental or spontaneous ignition or reaction of ignitable or reactive wastes, including, but not limited to, ignition or reaction in containers.*"

Review Approach

Identification of Oxidizing Chemicals

Compliance with these permit conditions requires knowledge of the chemicals present in a container and a determination of their compatibility with other materials in the container such as sorbents (i.e. Swheat™). Because Swheat™ is a natural, organic material, its incompatibility would be with oxidizing chemicals. Because the waste streams involve legacy waste, chemical analytical data from the waste generators for the four waste streams in the LTP Extent of Condition (EOC) review is minimal to nonexistent. Therefore, ENV-CP's review approach was as follows. The four waste streams in the LTP Extent of Condition review are addressed in two CCP Acceptable Knowledge (AK) documents (CCP-AK-006, rev. 13 and CCP-AK-004, rev. 7). These two CCP AK documents were selected because, upon review, ENV-CP determined that they effectively summarize all the LANL AK documentation that is currently available regarding the historical chemical composition of the four waste streams. Therefore, the chemical summaries in the two CCP AK reports were reviewed to identify oxidizers in the four waste streams that might be potentially incompatible with Swheat™ or other organic sorbents.

Each CCP AK document contains a Chemical Identification and Use Summary Table that lists chemicals found in the MTRU waste streams addressed. Each Summary Table was checked to identify whether any chemicals listed would be classified as oxidizers.

These oxidizing materials were then checked, using EPA and DOT methodologies and data, to determine if a potential incompatibility exists.

EPA 40 CFR 264 Appendix V Compatibility Analysis

The first compatibility determination was completed using the EPA method and data in 40 CFR 264 Appendix V. LANL is conservatively considering Swheat™ to be a Reactivity Group 101 "Miscellaneous Combustible or Flammable Material" (i.e., a 40 CFR 264 Appendix V material in Group 6B) for purposes of this analysis. If a Group 6A (oxidizing) chemical is present in the CCP Chemical Identification and Use Summary Table, it would theoretically be incompatible with Swheat™ for purposes of this analysis. Oxidizing materials from the CCP AK documentation were compared to the chemical groups and classes listed in Compatibility Group 6A.

DOT 49 CFR 177 Compatibility Analysis

Two segregation requirements under DOT were used to assess potential incompatibility based on references to DOT requirements in the LANL Permit. DOT segregation requirements codified at 49 CFR 177.848 apply to the segregation of containers with differing hazard classes and divisions on trucks and transport tanks and not to the mixing of incompatible materials in a container. If used as a guide for incompatibility determination for mixing within a container, the oxidizing materials from the AK documents could not be mixed with materials in incompatible classes as shown on the Segregation Table For Hazardous Materials in 48CFR 177.848.

DOT 49 CFR 173 Compatibility Analysis

Actual compatibility requirements for mixtures in containers under DOT are provided in 49 CFR 173.24(e)(4), and do not provide a method for determining incompatibility. However, they do prohibit mixing of materials that would cause fires, create heat or toxic gases, etc. To determine potential incompatibility under 49 CFR 173.24(e)(4), the MSDSs for oxidizing materials were used to determine if mixing the chemical with Swheat™ could result in the hazardous conditions listed.

WIPP Appendix C-1 Compatibility Analysis

Finally the method outlined in Appendix C1 to the WIPP Part B Permit Application entitled “Chemical Compatibility Analysis of Waste Forms and Container Materials” was applied to the waste materials when mixed with Swheat™ for potential incompatibility. This method involves entering the materials into an unspecified database that checks for incompatibility based on the method outlined in the U.S. EPA document, *A Method for Determining the Compatibility of Hazardous Waste* (Hatayama et al.,1980). Although the database was unavailable for LANL use the materials were checked using the compatibility chart provided in the reference document.

Results

Identification of Oxidizing Chemicals

1. LA-MHD01, LA-CIN01.001[6] (debris waste stream, cemented cans waste stream)

Table 9 (Chemical Identification and Use Summary) in CCP-AK-006, rev. 13 lists chemicals found in the LA-MHD01 and LA-CIN01.001 waste streams. The following Group 6A chemicals (theoretically incompatible with Swheat™ per 40 CFR 264 Appendix V) were listed in CCP-AK-006 Table 9,

Table 1 Potentially Incompatible Chemicals - CCP-AK-006

Aluminum Nitrate	Magnesium Perchlorate
Antimony Pentafluoride	Mercuric Nitrate
Bromine	Perchloric acid (*probably present as perchlorate; 'perchlorate' is listed in Appendix V*)
Cerium Nitrate	Potassium Chromate
Cobalt Nitrate	Potassium Dichromate
Ferric Nitrate	Potassium Permanganate
Hydrogen Peroxide	Silver Nitrate
Magnesium Perchlorate	Sodium Chlorite
Lanthanum Nitrate	Sodium Chromate
Lead Nitrate	Sodium Nitrate

[6] *NOTE: CCP-AK-006 also covers LA-MIN02-V.001 (mixed absorbent waste stream). However, LA-MIN02-V.001 containers were not a subject of this analysis. Some LA-MIN02-V.001 containers are believed to have been remediated using WasteLock 770™; however, WasteLock™ remediation was not included in this analysis.*

The text of CCP-AK-006 also describes RCRA chemicals in the LA-MHD01 and LA-CIN01.001 waste streams. No Group 6A chemicals were listed in the text in addition to those in Table 9 mentioned above.

2. LA-MIN03-NC.001(cemented sludges from TA-50 RLWTF)

Table 8 (Chemical Identification and Use Summary) describes RCRA chemicals in the LA-MIN03-NC.001 waste stream. The following chemicals or chemical categories (potentially incompatible with Swheat™) were confirmed to occur in CCP-AK-004 Table 8:

Table 2 Potentially Incompatible Chemicals - CCP-AK-004

Aluminum Nitrate	Lanthanum Nitrate
Bromine	Mercuric Nitrate
Calcium Nitrate	Perchloric Acid (*probably present as perchlorate)*
Cerium Nitrate	Silver Nitrate
Chromic Acid	Sodium Chromate
Chromium Trioxide	Sodium Hypochlorite
Cobalt Nitrate	Sodium Nitrate
Ferric Nitrate	Sodium Perchlorate
Hydrogen Peroxide	Lanthanum Nitrate

Twenty (20) EPA Compatibility Group 6A chemicals were confirmed to occur in the LA-MHD01 and LA-CIN01.001 waste stream documentation. Eighteen (18) EPA Compatibility Group 6A chemicals were confirmed to occur in the LA-MIN03-NC.001 waste stream documentation.

40 CFR 264 Appendix V Compatibility Analysis

Because LANL is conservatively considering Swheat™ to be a Reactivity Group 101 "Miscellaneous Combustible or Flammable Material" (i.e., a 40 CFR 264 Appendix V material in Group 6B) for purposes of this analysis, all of the oxidizing materials listed in the Tables 1 and 2 above have a potential incompatibility with Swheat™ used as a sorbent.

DOT 49 CFR 177 Compatibility Analysis

All of the materials in the Tables 1 and 2 above would be considered Class 5.1 Oxidizers and as such would require segregation, under this section, from explosives, flammable liquids, poisonous liquids and corrosive liquids. Because Swheat™ is not a DOT hazardous material and has no assigned hazard class, a direct segregation determination cannot be made. This method would not be appropriate to make determinations for mixing substances within a drum or container.

DOT 49 CFR 173 Compatibility Analysis

Since the materials listed in Tables 1 and 2 are all classified as oxidizers, their MSDSs list a potential incompatibility with organic and/or flammable or combustible materials with the result being fire, heat generation, and toxic or asphyxiant gasses, all of which are prohibited for mixtures under 49 CFR 173.24(e)(4).

WIPP Appendix C-1 Compatibility Analysis

With the exception of hydrogen peroxide with a number 30, all of the chemicals listed in Tables 1 and 2 are strong oxidizers and are assigned a number 104 on the compatibility chart used for the Appendix C-1 analysis. Swheat™, as a combustible material, would be assigned number 101. In accordance with the compatibility chart, mixing Swheat™ (101) with strong oxidizers (104) could generate H (heat), F (fire), and/or G (gasses). Mixing Swheat™ with hydrogen peroxide (30) could generate H, F, and GT (toxic gasses). Therefore, Swheat™ as a sorbent would potentially be incompatible with any of the chemicals listed in the tables above.

Chemical Forms and Quantities

All chemicals listed in the Chemical Identification and Use Summary Tables in both CCP AK documents were assigned based on their reference as feed or process chemicals in procedures, material ordering documentation, and/or interviews with personnel performing operations. The chemicals would not be expected in the waste streams in pure form since they would have been involved in chemical reactions, decontamination activities, TRU recovery operations, and/or waste treatment processes prior to placement in their current waste containers. The quantities of chemical wastes will vary widely depending upon the type of waste and from one container to the next depending upon how much and what kind of cementation or sorption was applied and how many remediation activities were performed on each container.

The debris (LA-MDH01) waste stream, by volume, contains mostly materials and equipment that was contaminated through contact or use that has residual contamination such as gloves or other PPE, process containers or hoses, etc. Additionally the debris stream would include other combustible materials such as rags, plastic, and cellulose that would be in the same combustible class as Swheat™ but have not caused incompatibility issues during the 30+ years they have been in storage.

The cemented TRU waste stream (LA-CIN01) consists of waste materials that have been encased in Portland or gypsum cement. Again, these waste materials would have been subjected to reaction, decontamination, TRU recovery, and/or waste treatment or volume reduction prior to the cementation processes. The cementation process would reduce the oxidizing potential of the waste materials decreasing the likelihood of reactions with combustibles such as Swheat™.

The sludge waste stream (LA-MIN03) consists of dewatered waste materials from the treatment of wastewaters. These waste materials would also have been subjected to reaction, decontamination, TRU recovery, as well as the liquid waste treatment processes and dewatering prior to placement in the container with cement added to further solidify them. The addition of cement would reduce the oxidizing potential of the waste materials decreasing the likelihood of reactions with combustibles such as Swheat™.

Conclusions

Based on the conservative approach of using the CCP AK data for the waste streams, there are chemicals that could potentially be present in the waste that, in pure form and/or sufficient concentrations, could be incompatible with Swheat™ sorbent. Because determining precisely the incompatibility of wastes in specific containers with the sorbent added would be technically impossible at this point, LANL must report, conservatively at this time, that certain chemicals known to be incompatible with the sorbents used may be present in some of the waste streams analyzed. However, based on the fact that the incompatible chemicals would not be in their pure form and have been subject to process reactions and various dewatering, solidification, and other remediation processes which would reduce their oxidizing potential, and the lack of historical incompatibility reactions in containers of the subject wastes, the wastes should not be considered to be in danger of imminent reaction.

References

Hatayama et al. 1980. *A Method for Determining the Compatibility of Hazardous Waste*. EPA-600/2-80-076, USEPA, Washington D.C.

Appendix B.

Los Alamos NATIONAL LABORATORY EST. 1943

memorandum

Actinide Analytical Chemistry

To/MS: Bruce Robinson, ADEP, MS K491
David Funk, ADEP, MS J910
From/MS: Rebecca Chamberlin, C-AAC
Phone/Fax: 7-1841/Fax 5-4737
Symbol: C-AAC-15-0024
Date: June 24, 2015

SUBJECT: Analytical Results for Drum S8111785 Free Liquid Sample

Sample Summary	
Drum #	**S8111785**
Sample collection date	05/13/2015
Analysis start date	05/28/2015
Sample description	Heterogeneous: Brown liquid with lighter-colored sludge that was difficult to keep in suspension. After settling 10 min, the solids were ~25% of volume of the sample.
Sample mass	55.2 g
Sample volume	41 mL
Density (calculated)	1.35 g/mL
pH (potentiometric)	10.9
Radionuclides (NDA, SNAP)	**Ci/mL** (+/- 30% modeling uncertainty)
Pu-239	Not detected
Am-241	1.91E-10
Cs-137	7.71E-12
Anions (Ion Chromatography)	**g/100 mL** (+/- 10%)
Nitrate (NO_3^-)	32.2
Nitrite (NO_2^-)	2.7
Chloride (Cl^-)	0.4
Fluoride (F^-)	Not detected
Sulfate (SO_4^-)	1.1
Oxalate ($C_2O_4^-$)	Trace
RCRA Metals (ICP-MS/AES)	**µg/mL** (+/- 20%)
Silver (Ag)	0.035
Arsenic (As)	<0.9
Barium (Ba)	1.7
Cadmium (Cd)	0.14
Chromium (Cr)	34
Mercury (Hg)	0.30
Lead (Pb)	590
Selenium (Se)	<1.4

Major Elements (ICP-MS/AES)	µg/mL, except as noted (+/- 20%)
Sodium (Na, %)	12.4 g/100 mL
Potassium (K, %)	1.2 g/100 mL
Aluminum (Al)	200
Calcium (Ca)	72
Iron (Fe)	50
Magnesium (Mg)	21
Silica (SiO_2, crystobalite)	Detected in undigested residue

Sample photos

As-received sample,
after mixing

As-received sample,
after standing 10 min

Analytical procedures and work instructions used:

1) ANC 212, Ion Chromatography
2) ANC 102, Inductively Coupled Plasma—Mass Spectrometry Using the VG Elemental Plasma Quad
3) ANC 221, Operating the Jobin-Yvon (JY) Inductively Coupled Plasma – Atomic Emission Spectrometer
4) WI-5, Analytical Sample Receipt, Subsampling, and Distribution within Analytical Chemistry
5) WI-30, Chemical Analysis, Characterization and Research
6) WI-42, Radiochemical Research and Development at CMR
7) WI-57, X-ray Diffraction
8) ANC 214, Spectrophotometric Determination of Silicon in Plutonium Materials (potentiometric pH method)

Cy: C-AAC File

Appendix C

Los Alamos
NATIONAL LABORATORY

memorandum

M-DO: Explosive Science & Shock Physics
M-7: High Explosives Science & Technology

To/MS: David J. Funk, ADEP, djf@lanl.gov
From/MS: Geoffrey Brown, M-7, geoffb@lanl.gov GWB 7/10/15
Phone/Fax: 7-6718 / 7-0500
Symbol: M7-15-6008
Date: July 10, 2015

SUBJECT: (U) Decomposition Onsets for Dried Swheat Mixtures in Analytical Lab 52143

M-7 recently carried out differential scanning calorimetry (DSC) testing of samples related to Waste Isolation Pilot Plant (WIPP) waste forms. The samples were

1. 1:1 ratio of saturated solution of WB8 mixed with Swheat kitty litter
2. 3:1 ratio of saturated solution of WB8 mixed with Swheat kitty litter
3. 1:1 ratio of 45 wt.% $NaNO_3$ mixed with Swheat kitty litter
4. 3:1 ratio of 45 wt. % $NaNO_3$ mixed with Swheat kitty litter

After the initial DSC runs, the samples were then dried for one week at room temperature in a hood. The DSC testing was then repeated.

Drying samples 1 and 2 changed them only minimally. Their exothermic activity before and after drying occurred at high temperatures with onsets of decomposition between 250 ˚C and 325 ˚C.

Samples 3 and 4 also changed minimally upon drying. Both showed a residual broad endotherm centered near 100 ˚C and a broad exotherm ranging from 150 ˚C to 400 ˚C. The 1:1 mixture showed some sharper features within the endotherm and exotherm regions but no feature on either dried sample exceeded 2 W/g heat flow. Given that the nominal baseline of the instrument can be +/- 1 W/g heat flow, the signals from the dried samples indicate minimal exothermic activity.

The onset of the exothermic activity of samples 3 and 4 cannot be explicitly determined because of the residual endotherm. Based on our experience with energetic materials however, it is very unlikely that both features became stronger after drying and are masking each other. As a result we expect that the exothermic onsets of samples 3 and 4 are in the 125 ˚C range.

GB:mq

Cy: M-DO DCM File, P942, wxdct@lanl.gov

Reviewed and determined to be UNCLASSIFIED.
This review does not constitute clearance for public release.
Derivative Classifier: Geoffrey Brown
Date: July 09, 2015

M-7 High Explosives Science and Technology

52143

Analytical Laboratory Report

Analytical Lab # 52143

Requester: BROWN **Group: M-7**

Sample ID: 45wt% NaNO3 Swheat (1:1), 45wt% NaNO3 Swheat (1:3), Saturated WB8 Swheat (1:1), Saturated WB8 Swheat (1:3) wet and dry

Tests Completed	Date Completed	Analyst
150611001		
DSC (wet)	06/11/15	SANDSTROM
DSC (dry)	06/24/15	SANDSTROM
150611002		
DSC (wet)	06/11/15	SANDSTROM
DSC (dry)	06/24/15	SANDSTROM
150611003		
DSC (wet)	06/11/15	SANDSTROM
DSC (dry)	06/24/15	SANDSTROM
150611004		
DSC (wet)	06/11/15	SANDSTROM
DSC (dry)	06/24/15	SANDSTROM

This document deemed Unclassified by
Mary M Sandstrom 7/9/15
(DC)

Validated: Geoffrey W. Brown 7/9/15

Approved: Mary M. Sandstrom 7/9/15

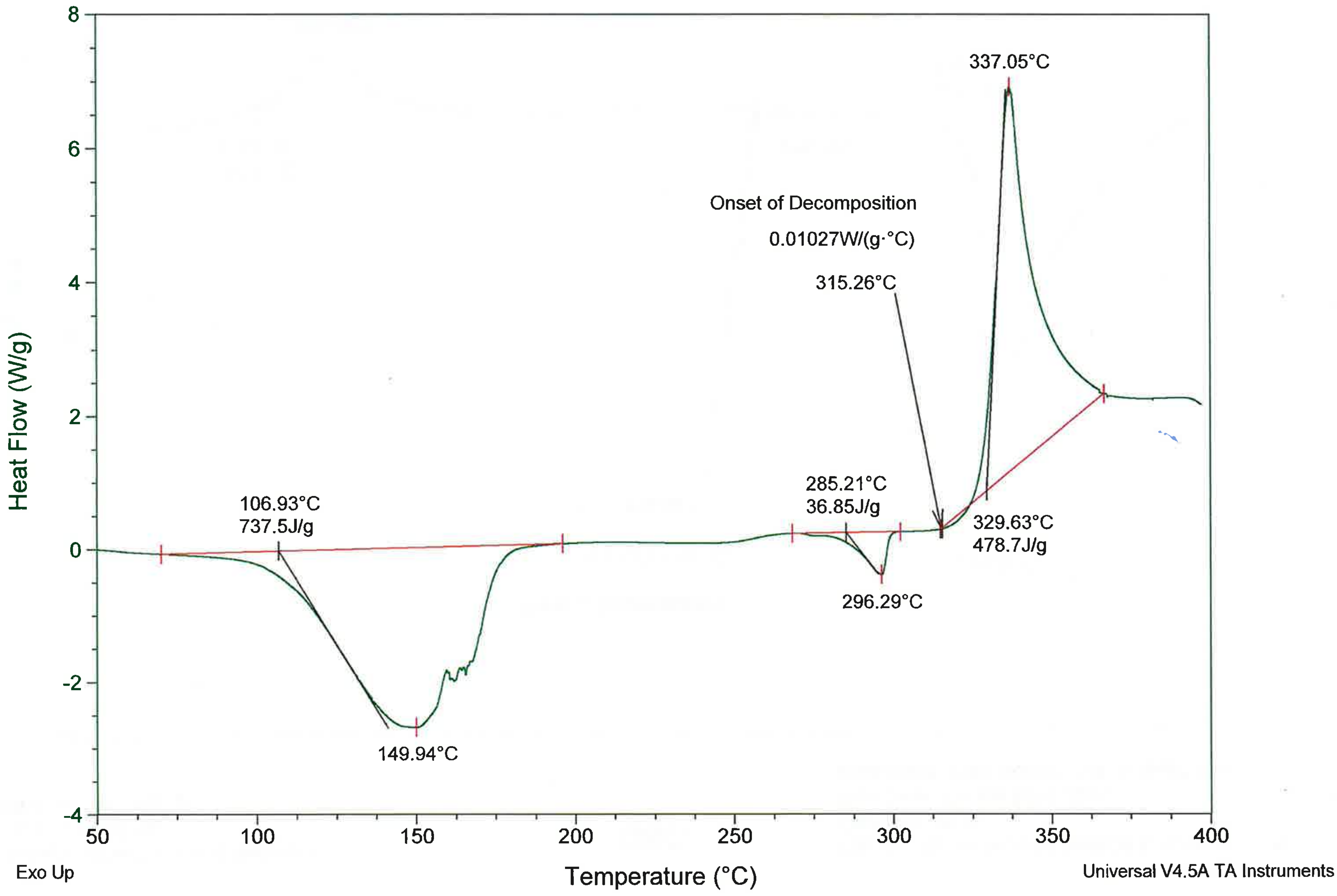
Date Submitted: 06/11/2015
Date Competed: 06/24/2015

Los Alamos NATIONAL LABORATORY

Sample: 45wt% NaNO3 Swheat (1-1)
Size: 2.7720 mg
Method: 10C Ramp

DSC

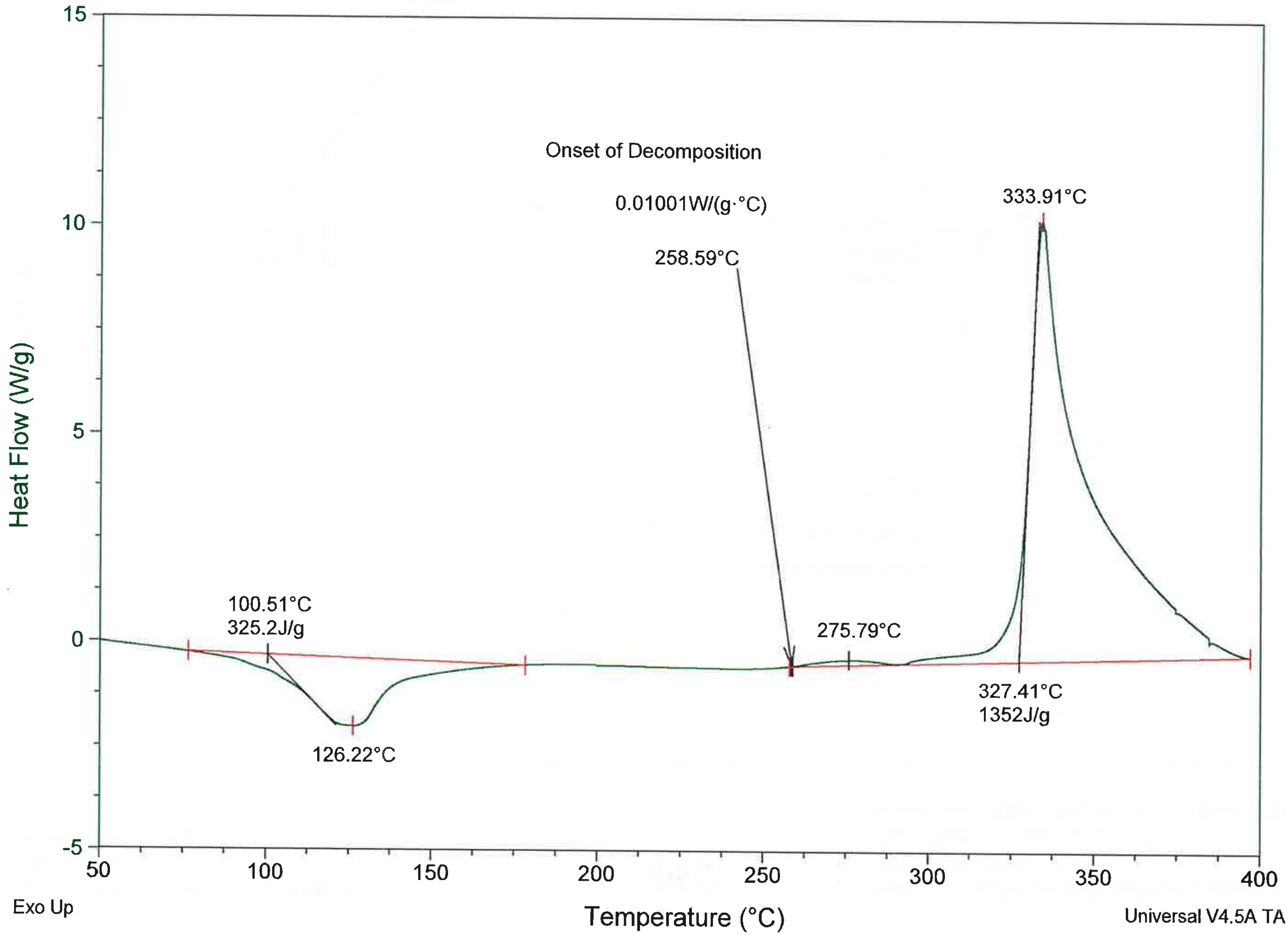
File: C:...\52143\45wt% NaNO3 Swheat (1-1).001
Operator: MMS
Run Date: 11-Jun-2015 21:55
Instrument: DSC Q2000 V24.11 Build 124



Sample: 45wt% $NaNO_3$ Swheat (3-1)
Size: 1.0430 mg
Method: 10C Ramp

DSC

File: C:...\52143\45wt% NaNO3 Swheat (3-1).001
Operator: MMS
Run Date: 11-Jun-2015 22:45
Instrument: DSC Q2000 V24.11 Build 124

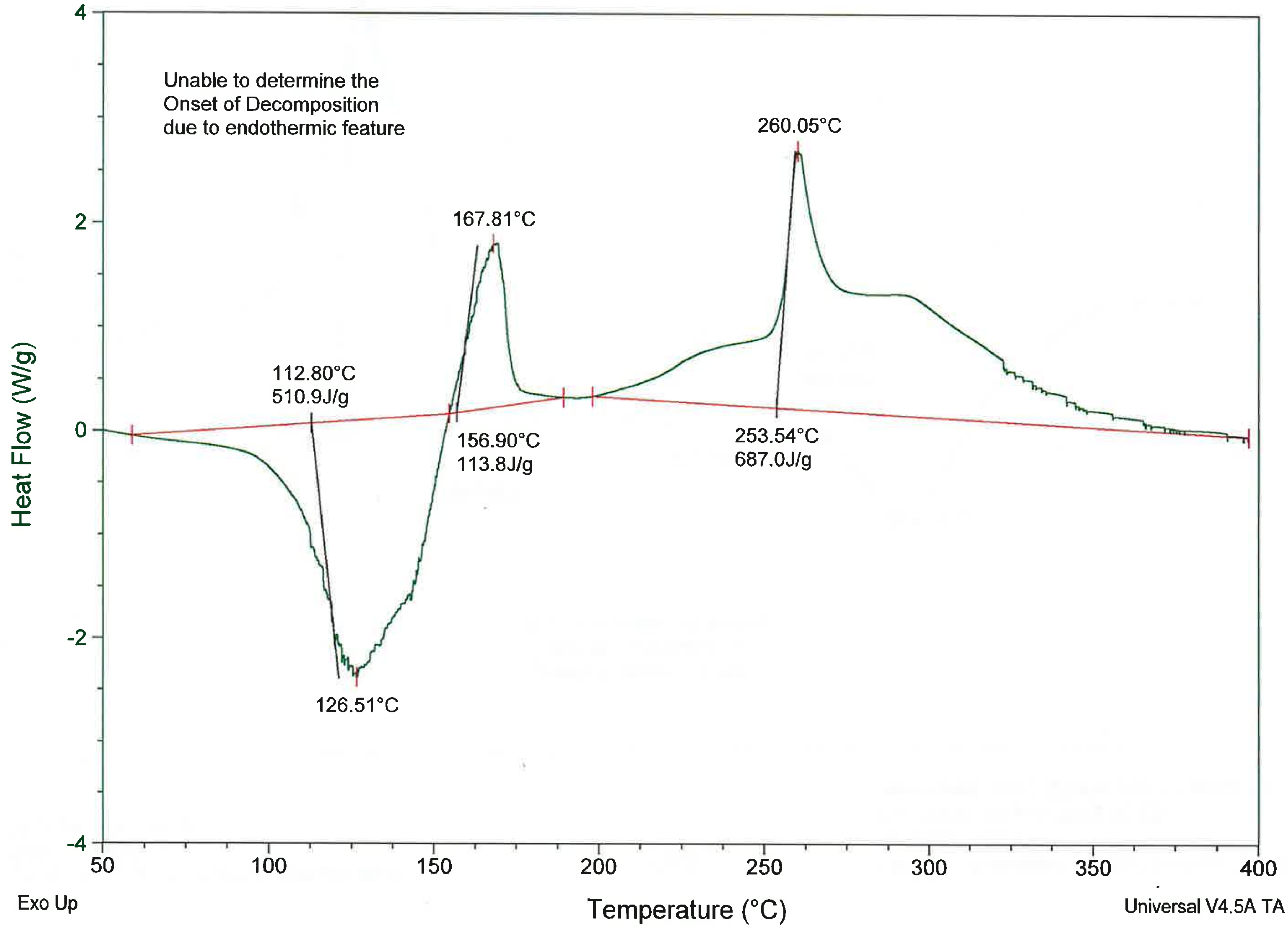


Universal V4.5A TA Instruments

Sample: Saturated NaNO3 Swheat (1-1)
Size: 1.9080 mg
Method: 10C Ramp

DSC

File: C:...\Saturated NaNO3 Swheat (1-1).001
Operator: MMS
Run Date: 11-Jun-2015 23:35
Instrument: DSC Q2000 V24.11 Build 124

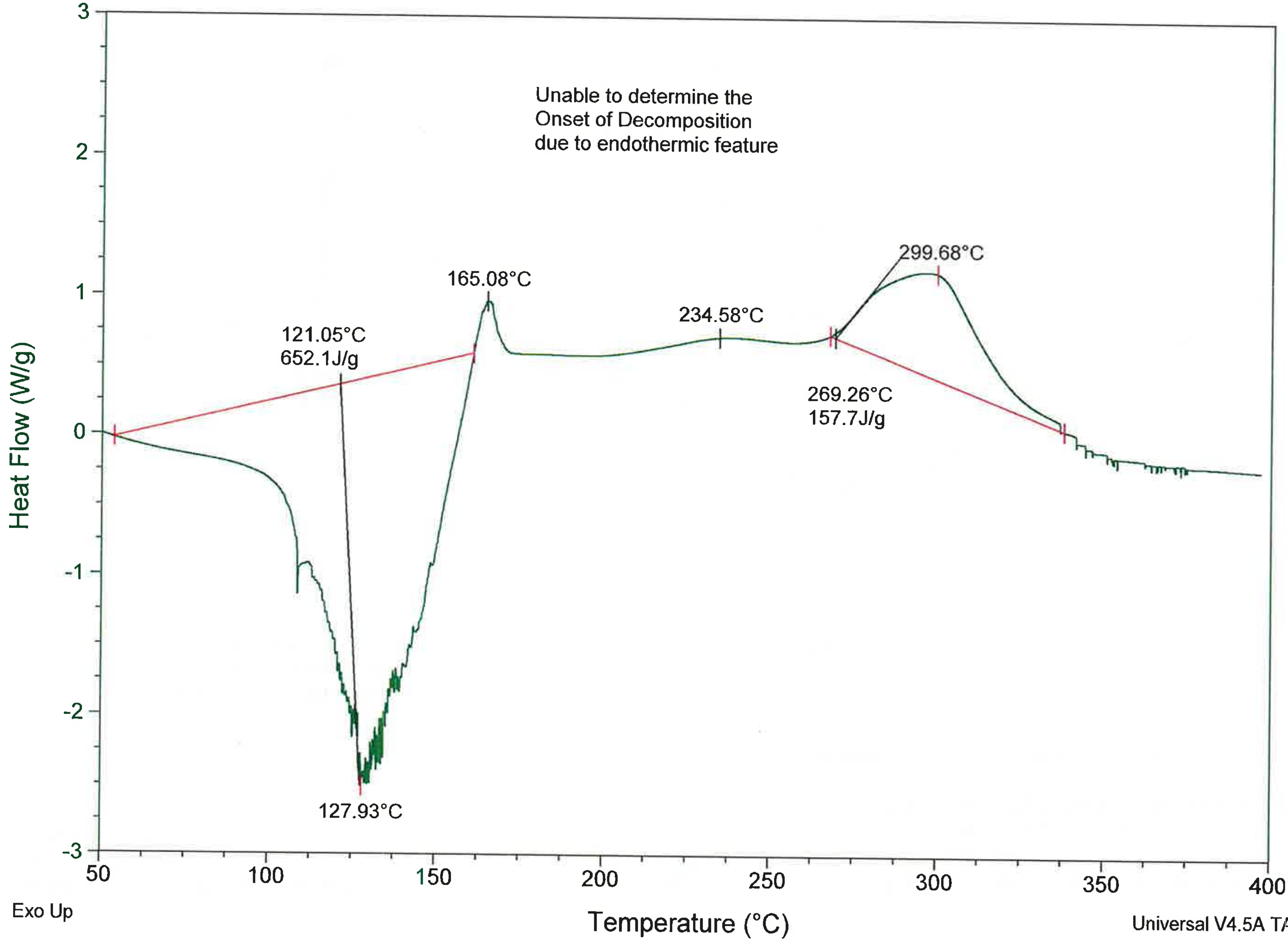


Universal V4.5A TA Instruments

Sample: Saturated NaNO3 Swheat (3-1)
Size: 1.5030 mg
Method: 10C Ramp

DSC

File: C:...\Saturated NaNO3 Swheat (3-1).001
Operator: MMS
Run Date: 12-Jun-2015 00:25
Instrument: DSC Q2000 V24.11 Build 124

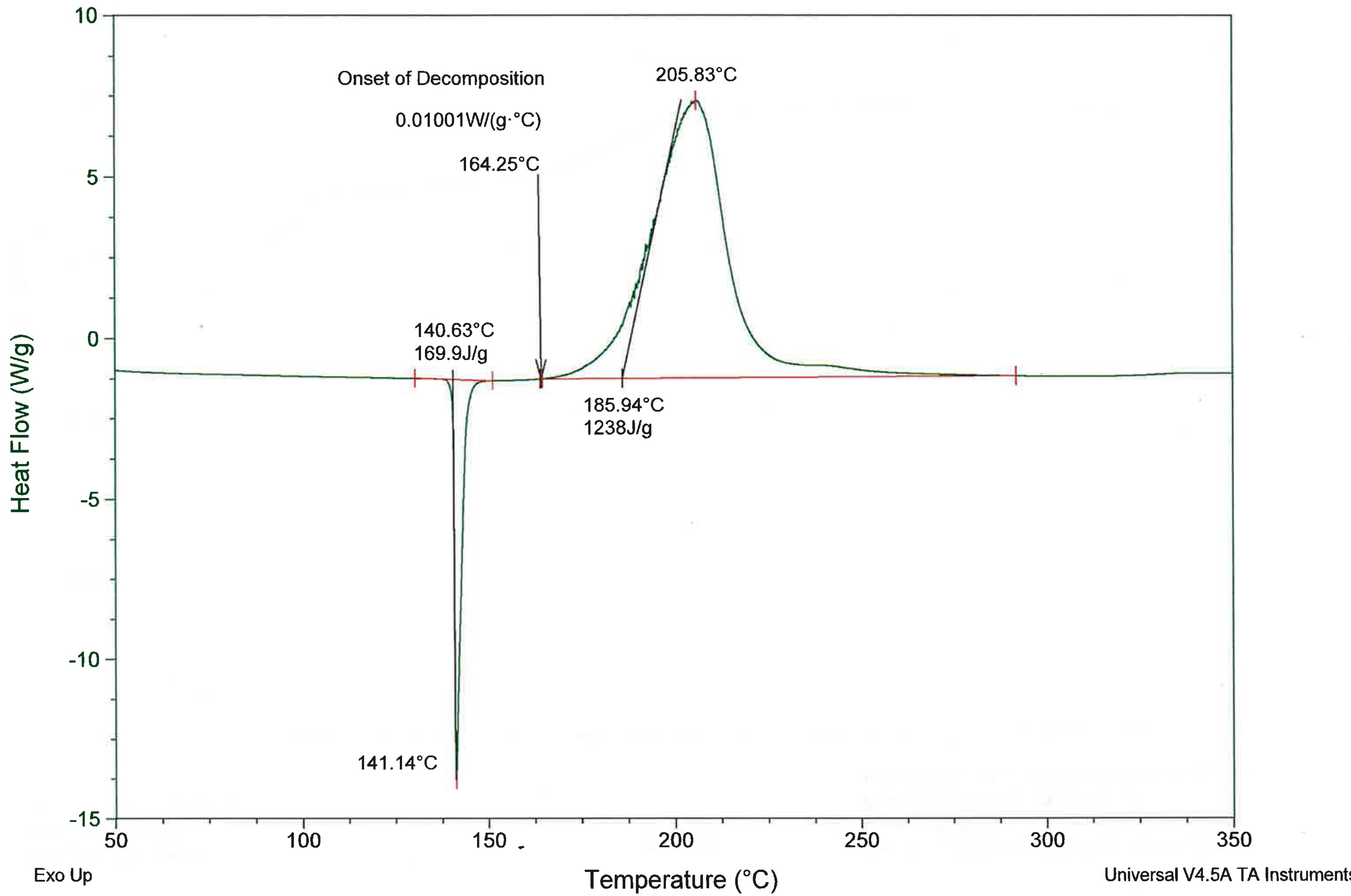


Universal V4.5A TA Instruments

Sample: PETN 9401
Size: 0.8960 mg
Method: 10C Ramp

DSC

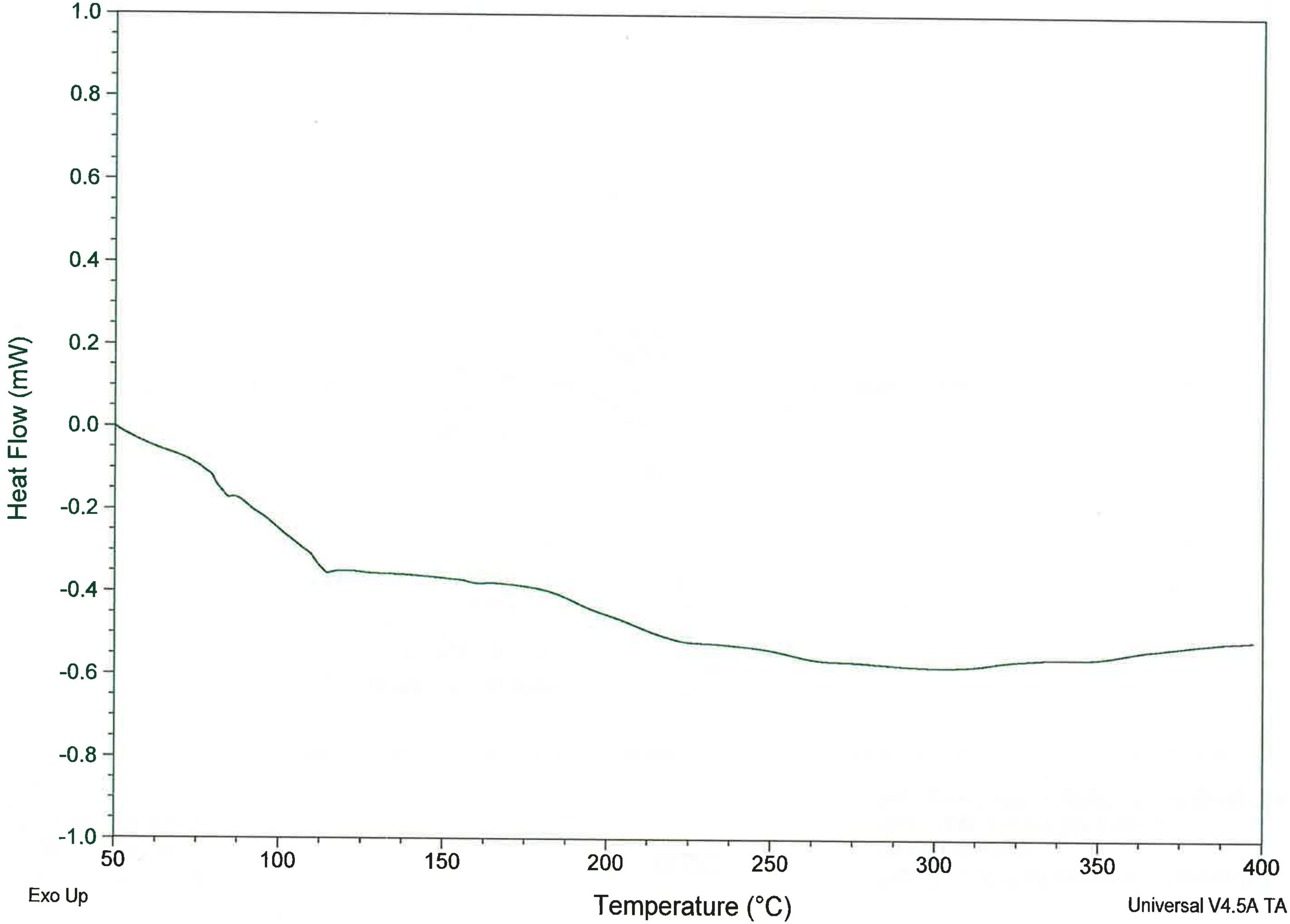
File: C:...\061115 Instrument Control.001
Operator: MMS
Run Date: 11-Jun-2015 16:42
Instrument: DSC Q2000 V24.11 Build 124



Sample: Pan Blank
Size: 0.0000 mg
Method: 10C Ramp

DSC

File: C:...\2015\061115 Pan Blank.002
Operator: MMS
Run Date: 11-Jun-2015 15:52
Instrument: DSC Q2000 V24.11 Build 124



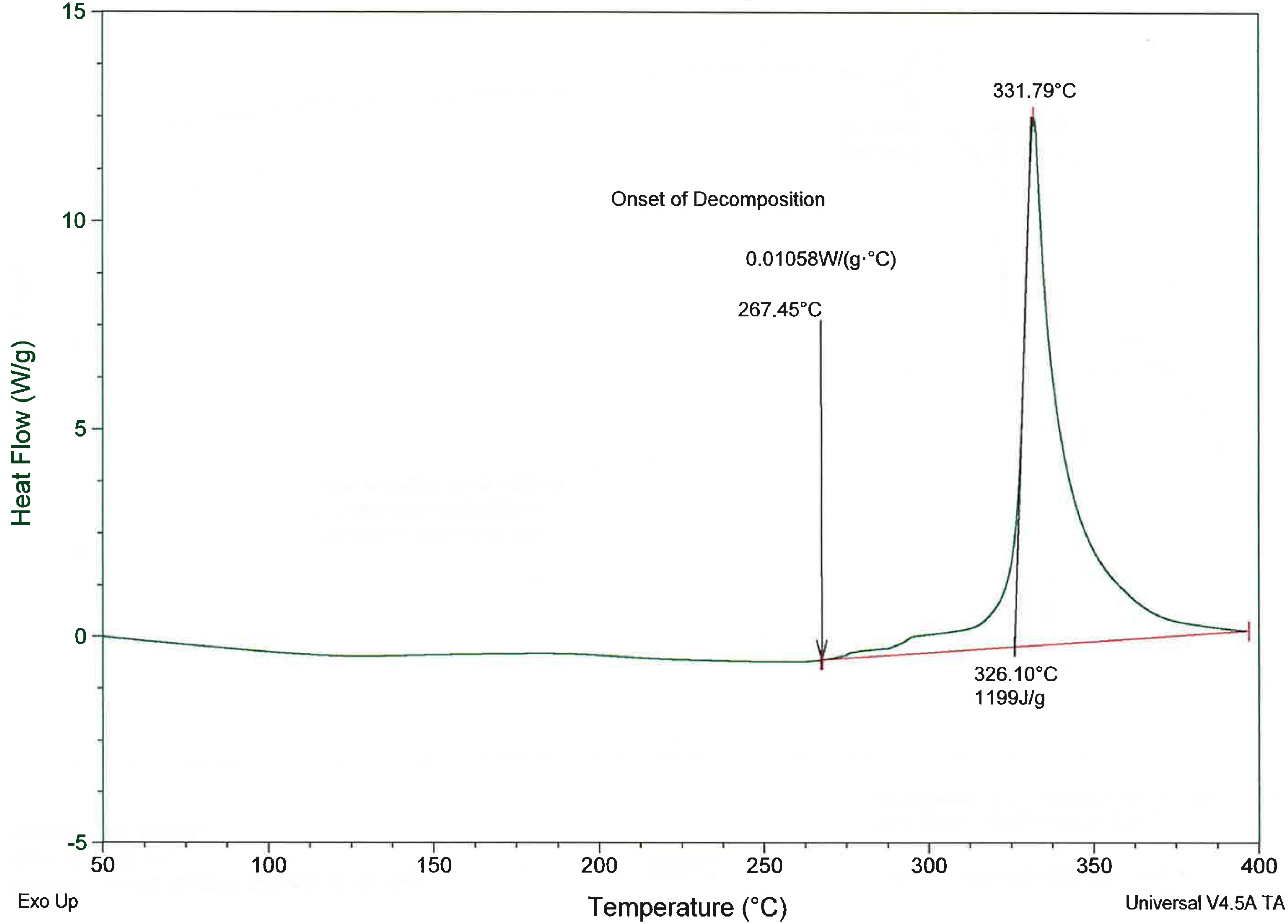
Universal V4.5A TA Instruments

Sample: 45wt% NaNO3 Swheat (3-1)- Dry
Size: 1.2460 mg
Method: 10C Ramp

DSC

File: C:...\45wt% NaNO3 Swheat (3-1)- Dry.001

Run Date: 24-Jun-2015 04:32
Instrument: DSC Q2000 V24.11 Build 124



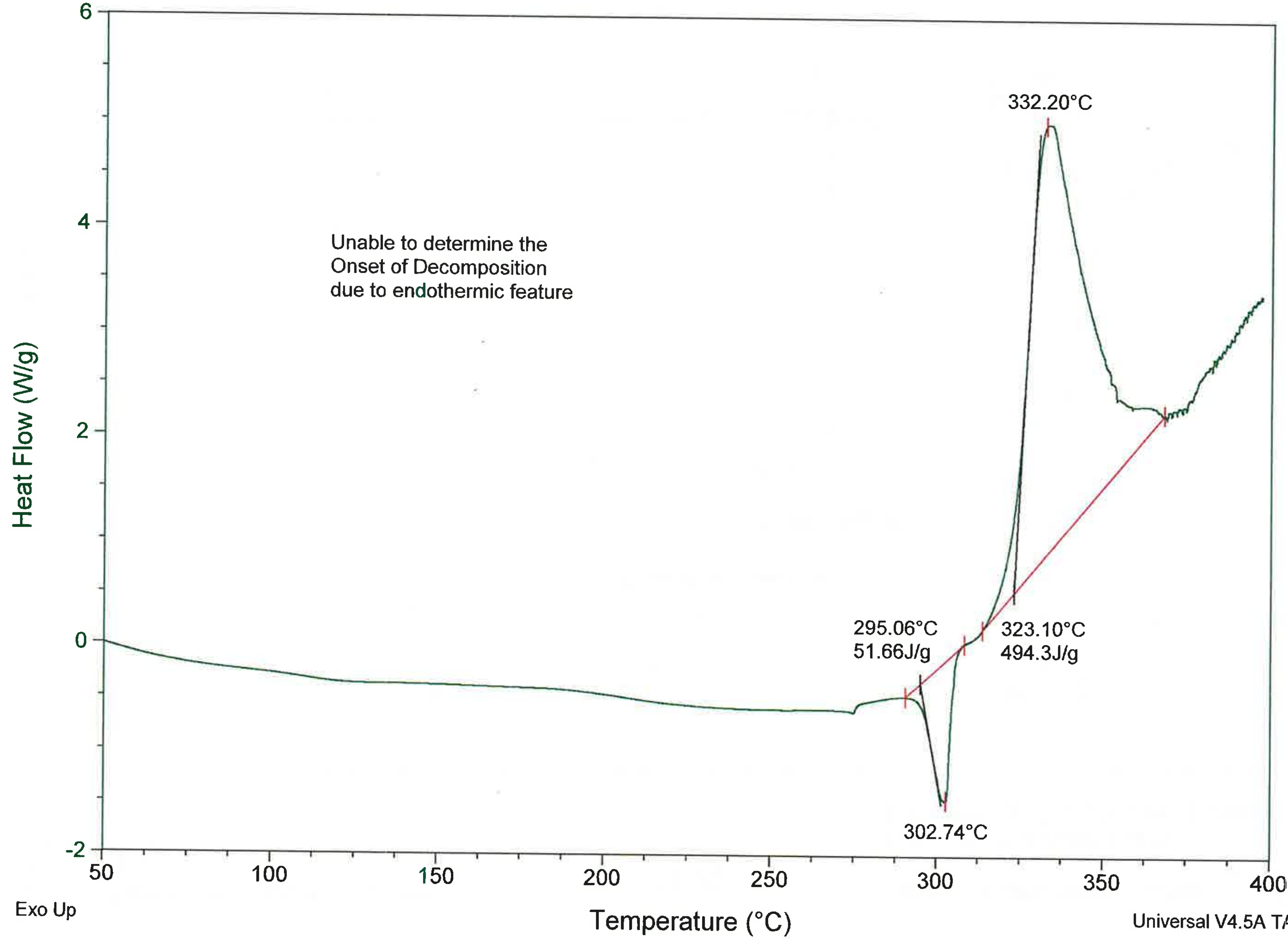
Universal V4.5A TA Instruments

Sample: 45wt% $NaNO_3$ Swheat (1-1)- Dry
Size: 0.9840 mg
Method: 10C Ramp

DSC

File: C:...\45wt% NaNO3 Swheat (1-1)- Dry.001

Run Date: 24-Jun-2015 05:22
Instrument: DSC Q2000 V24.11 Build 124



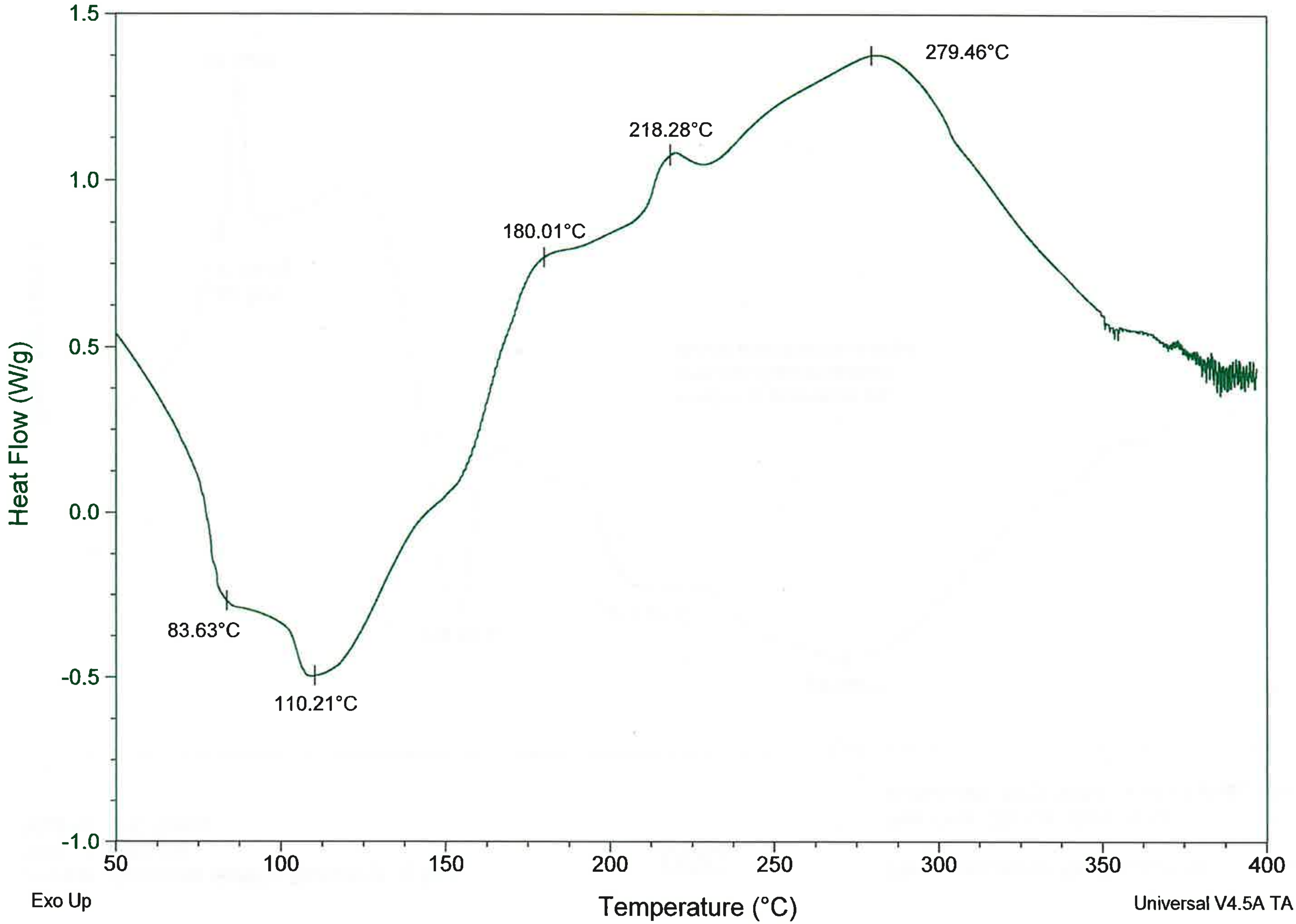
Universal V4.5A TA Instruments

Sample: Saturated NaNO3 Swheat (3-1) Dry
Size: 0.8650 mg
Method: 10C Ramp

DSC

File: ...\Saturated NaNO3 Swheat (3-1) Dry.001

Run Date: 24-Jun-2015 07:02
Instrument: DSC Q2000 V24.11 Build 124



Exo Up

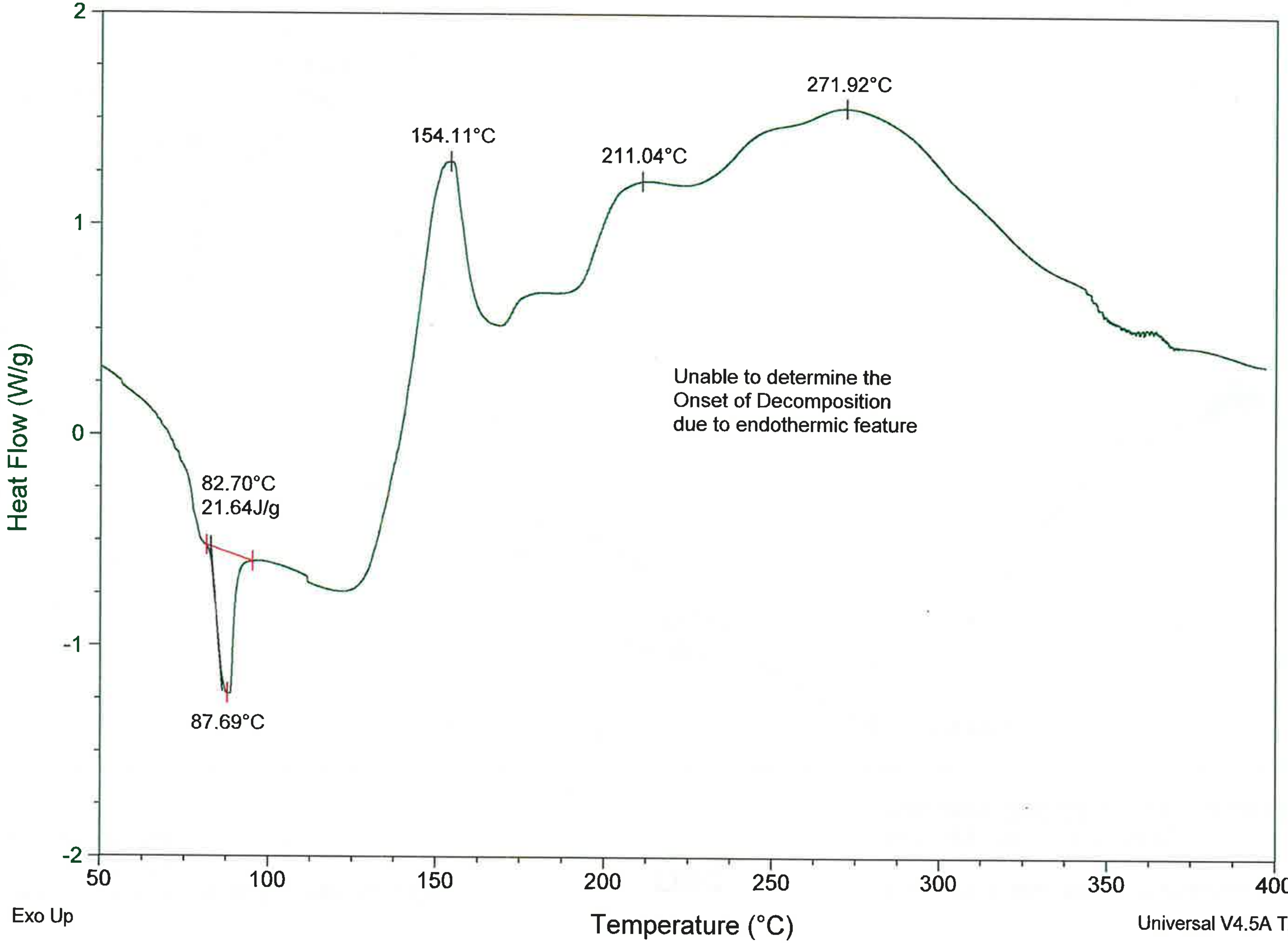
Universal V4.5A TA Instruments

Sample: Saturated NaNO3 Swheat (1-1) Dry
Size: 1.2040 mg
Method: 10C Ramp

DSC

File: ...\Saturated NaNO3 Swheat (1-1) Dry.001

Run Date: 24-Jun-2015 06:12
Instrument: DSC Q2000 V24.11 Build 124



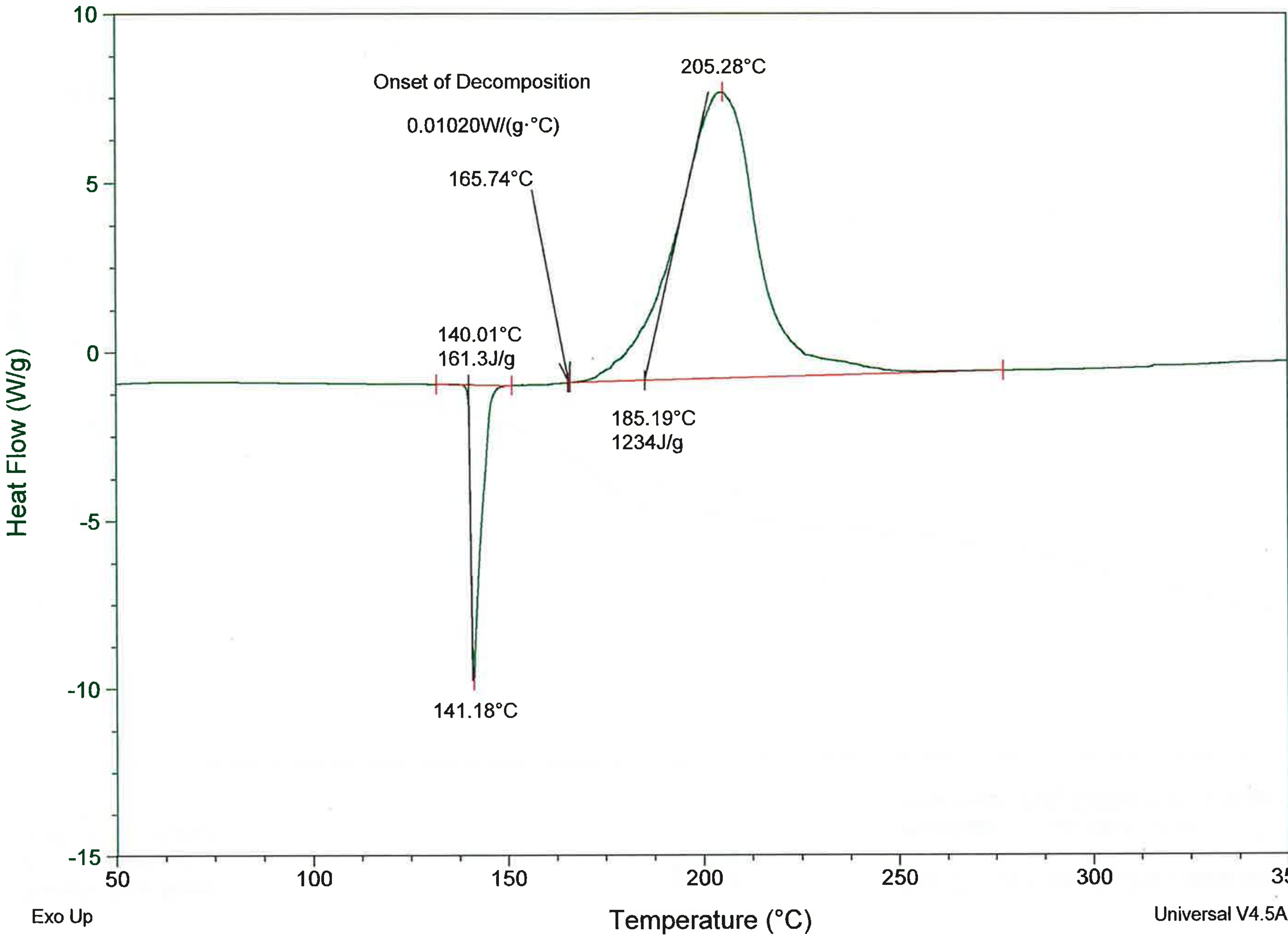
Universal V4.5A TA Instruments

Sample: PETN 9401B
Size: 0.9320 mg
Method: 10C Ramp

DSC

File: C:...\062315 Instrument Control.001

Run Date: 23-Jun-2015 18:10
Instrument: DSC Q2000 V24.11 Build 124



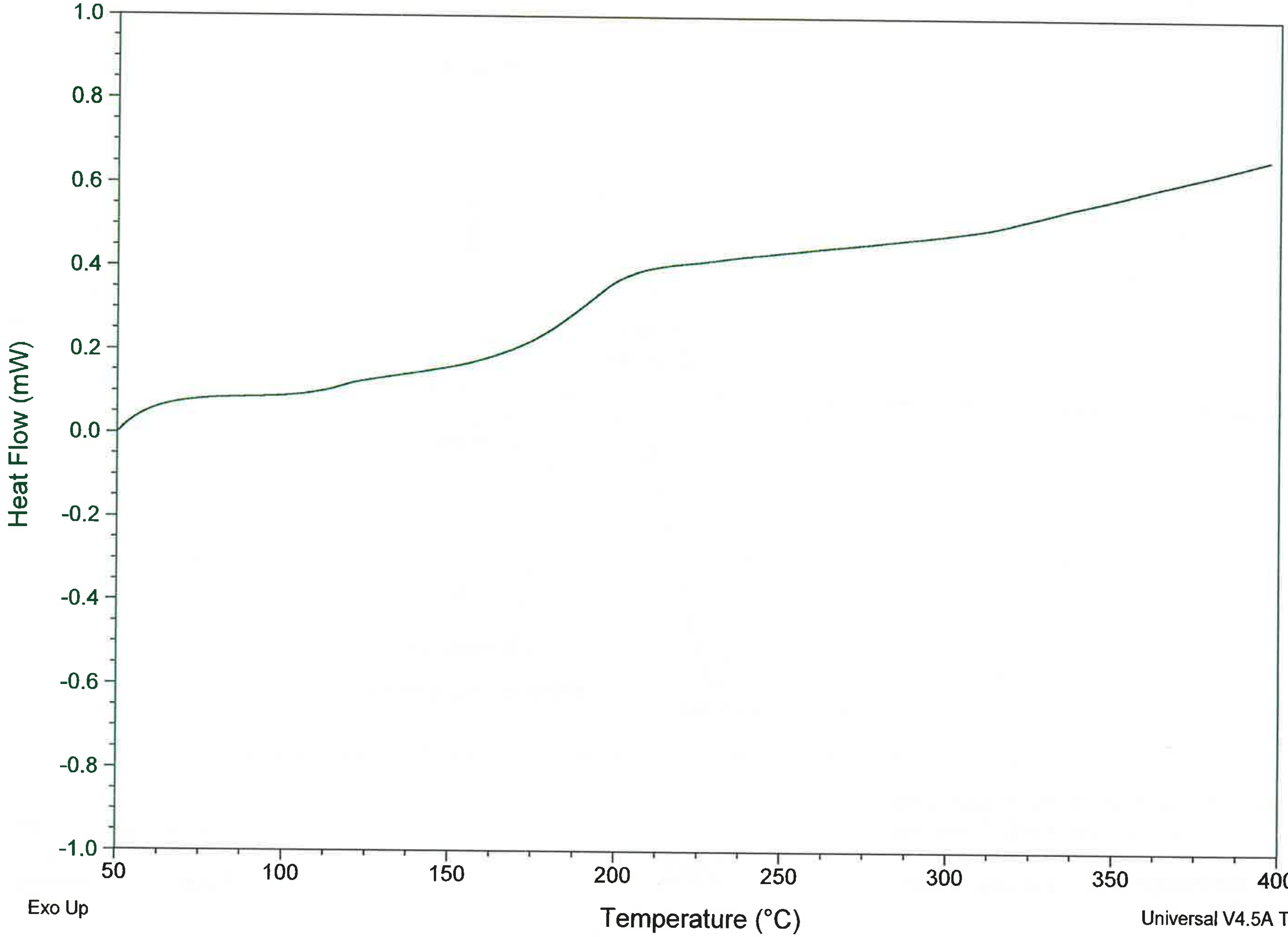
Universal V4.5A TA Instruments

Sample: Pan Blank
Size: 0.0000 mg
Method: 10C Ramp

DSC

File: C:...\2015\062315 Pan Blank.001

Run Date: 23-Jun-2015 17:20
Instrument: DSC Q2000 V24.11 Build 124



Universal V4.5A TA Instruments