

PROJECT: Skeletal recovery and research of Bwindi mountain gorillas, Bwindi Impenetrable National Park, Uganda

UWA Ref. Code: COD/96/05

Project Dates: July 15, 2017 – July 14, 2020

Location: Bwindi Impenetrable National Park (BINP)

Applicant: Dr. Shannon McFarlin, Assoc. Professor, The George Washington University (GW)

Core Partners: Uganda Wildlife Authority; Aggrey Rwetsiba, Senior Monitoring & Research Coord. Institute of Tropical Forest Conservation; Dr. Robert Bitariho, Director

Collaborating Partners: Mountain Gorilla Veterinary Project (MGVP); Dr. Mike Cranfield, Director Max Planck Inst. Evol. Anthr. (MPI-EVAN); Dr. Martha Robbins, Research Scientist

Other collaborators: Dr. Juho-Antti Junno, Asst. Professor, University of Oulu (UO)

Progress Report: January 30 – February 10, 2018 Field Activities

Participants

- UWA: Tindimwebwa Vastine, Joseph Chance, Arinaitwe Joseph
- ITFC: Tibenda Emmanuel, Nkwasiabwe Aventino
- Porters: December Lazarus, Arinaitwe Joseph, Bimaisha Godfrey, Kyomukama Charles, Ndabakyenga Topher, Mugenyi Moses
- Gorilla Doctors: Dr. Fred Nizeyimana
- USA/Finland: Drs. Shannon McFarlin (GW); Juho-Antti Junno and Markus Paananen (OU)

Progress towards objectives

- **Locate and excavate burials in the Buhoma sector of BINP:** (Summarized in Table 1).
 - Working with UWA and ITFC staff, we recovered skeletons of 5 mountain gorillas in the Buhoma sector, BINP. Two of these burials were on our original list: RUHONDEZA (SB), MWIRIMA (SB). Others we learned about through conversations with UWA and MGVP staff, and porters: TWEHEYO (INF), SEMI-HABITUATED ADF, BINYONKO (ADF). (See Figures 1-6).

TABLE 1: Burials recovered from the Buhoma sector, BINP, January 30-February 6th, 2018

Group	Age	Sex	Gorilla name	Year	Burial area	Location GPS	Vet/ pathologist(s)	Note
Mubare	SB	M	Ruhondeza	2012	Buhoma HQ near old offices	0793430/9893918	Fred Nizeyimana	
Rushegurura	SB	M	Mwirima	2014	Near Buhoma Park HQ.	0791040/9890445	Fred Nizeyimana, Jan Ramer	
Habinyanja	AD	F	Binyonko	2016	Kibirangwe; community land	0791881/9891812	Fred Nizeyimana	Killed by stone
Habinyanja	INF	M	Twekeyo	2016	Buhoma HQ near old offices	0793430/9893918*	Fred Nizeyimana	
(unhabit)	AD	F	unnamed	2015	Waterfall trail		Fred Nizeyimana	Broken legs

- We searched for two burials, but were unable to locate them:
 - MUTESI (Kancherere area). We searched for this burial with Retired UWA Head Tracker Charles Kyomukama on 2nd February, 2018.
 - NYAMUNWA (Hakondo area). Emmanuel TIBENDA and UWA Head Tracker Tito searched for this burial on 4th February, 2018.
- Other burials on the list have not yet been recovered to date. This list may not be exhaustive; there may be other burials not listed here. (See Burial list provided in Appendix 1).
- **Clean, catalogue and inventory** newly recovered skeletal specimens. (See Collection Catalogue provided in Appendix 2).
 - The five newly-recovered skeletons were transported to ITFC Ruhija, where they were cleaned, catalogued and stored.
- **Capacity Building – Training.** Working with UWA staff (Tindemwebwa, Joseph) and ITFC staff (Tibenda, Nkwasiabwe) in all of the above activities, we *continued* training in the following areas to build local expertise:
 - We reviewed the following protocols developed in Year 1, and targeted new knowledge development through more practice, particularly during excavations:
 - Skeletal cleaning, labeling, inventory and cataloguing
 - Skeletal excavation protocols
 - Training on skeletal anatomy/identification. We worked on further development of skeletal anatomy expertise through more practice during excavation, cleaning and inventory efforts. To this end, Tindemwebwa, Joseph, Tibenda, and Nkwasiabwe also played a more active role in conducting all excavations, alongside McFarlin and Junno, to move towards more proficiency in these protocols.
- **Other.**
 - We were asked by Warden Chemonges to advise on cleaning and preparation efforts of the recent SB carcass, Kanyonyi. The skin had been removed and salted for taxidermy, and the remainder of the carcass also stored intact.
 - Recommendations:
 - Storing the skin on the floor is not conducive to good preservation, as it will tend to accumulate moisture and eventually the hair will degrade. It is suggested to lift the skin off the floor and let it lie flat on a wooden rack; this allows air circulation across all surfaces to facilitate drying. Also recommend removing the existing salt (currently moist) and replace with new salt.
 - Once the skin is prepared, it is not necessary to mount the skin over the

skeleton. Instead, we recommended preparing the skin and skeleton separately. For the skin, this can be prepared over an underlying frame, shaped in the form of a gorilla. Juho-Antti Junno offered to send recommendations from a taxidermist colleague, if this would be helpful.

- To clean the skeleton, a Tergazyme bath is recommended, as per the protocols currently in place for the skeletal project. Otherwise, if left to dry as is, the soft tissue will harden over the bones, and this will be very difficult to clean. Tergazyme is an enzymatic detergent, which gently breaks down soft tissues but leaves bone and tooth tissues intact. To prepare the Tergazyme bath, a container large enough for submersing the carcass is necessary. Vastine Tindemwebwa and Chance Joseph have been trained on this protocol; this protocol is also provided here as an attachment. We left two boxes of Tergazyme behind with UWA for this purpose.

Challenges and Recommendations

- ***We faced challenges in the process of locating and excavating burials in BINP. These challenges are addressed for future mountain gorilla burials in a PROPOSED BURIAL PROTOCOL, provided as an attachment.***
 - In two cases, MUTESI and NYAMUNWA, we were unable to locate GPS-documented burials in the Buhoma sector of BINP. GPS coordinates did not appear to be accurate, and the graves were not marked at the surface.
 - RECOMMENDATION: Implement a burial protocol, which includes (1) collection of accurate GPS information, (2) marking of burials at the surface (e.g., with flowers or stones), and (3) recording burials in the form of a ‘burial report’. The excavation process would also be more efficient if all future burials were dug to a standard depth.
 - RECOMMENDATION: If possible, have a skeletal project participant (Joseph, Nkwasiabwe, Tibenda, or Tindimwebwa) present during future burials, to advise on burial procedures.
 - In many cases, large stones were placed inside the grave in an effort to fill in the burial hole. However, this has potential to crush, break or otherwise damage the skeleton, particularly when these stones are placed above the skeletons in the burial shaft. This was the case for BINYONKO, whose skeleton was broken in many places due to crushing by overlying stones. (See Figure 4).
 - RECOMMENDATION: Specify in the burial protocol that stones should not be placed in the grave.
 - Having the necropsy list was extremely helpful in our planning of field activities. However, we also learned of other burials that were not on the list. We believe there may still be other recoverable burials in the Buhoma sector, to be the focus of efforts in June-July, 2018.
 - RECOMMENDATION: With UWA and MGVP, consolidate all available information about gorilla burials in BINP, update the burial list (attached), and implement a reporting system for future burials.

Future Objectives: June-July, 2018

June-July, 2018 Visit (2-3 weeks, schedule TBD)

- **Meet with partners** to discuss:
 - Progress, revisit short- and long-term project objectives
 - Current protocols; specifically discuss the proposed burial protocol
 - Specific objectives for workshop training, to be held in June-July, 2018 or the following January, 2019
- **Locate and excavate the following burials in the Ruhija and Buhoma sector of BINP:**
 - RUHIJA: **ZEUS (SB)**, located at UWA Headquarters, Ruhija.
 - BUHOMA: Based on conversations with trackers, we believe there are additional recoverable burials in the Buhoma sector. These include those listed in Table 2, though there may be others. **Before June, 2018, it would be helpful to confirm whether there is specific knowledge of these burial locations, and whether there are additional burials to be added to this list.**

TABLE 2: Burials still to be recovered from the Buhoma sector, BINP.

Group	Age	Sex	Name	Year	Burial area	Location GPS	Vet/ pathologist(s)	Notes
Katendegere	SB	M	Mugurusi	1996		?	UWA vet ?	
Katendegere	INF	M	Ruhara	1996		?	UWA vet ?	
Mubare	JUV	M	Kawere	1998		?	UWA vet ?	
Habinyanja B	INF	M	Unnamed	2002	Rangers camp	?	Mike Cranfield, John Bosco Nizeyi	
Habinyanja B	INF	M	Unnamed	2002		?	Gladys Kalema	
Habinyanja	INF	M	Unnamed	2004		?	Innocent Rwego, Gladys Kalema	
Mubare	INF	M	Bukumu baby	2004		?	Chris Whittier, Benard Ssebide	
Mubare	INF	M	Bukumu baby	2004		?		
Mubare	INF	M	Bukumu baby	2005		?		
Habinyanja	INF	F	Binyonko baby	2007		?	Benard Ssebide, Denis Muhangi	
Mubare	INF	M	Bukumu baby	2007		?		
Mubare	ADF	F	Kashongo	2009		?	Mike Cranfield, Benard Ssebide	
Mubare	INF	M	Kashongo bat	2009		?	Mike Cranfield, Benard Ssebide	
Mubare	INF	M	Kashundwe ba	2009	Muzabagiro loop	0790033/ 9890948	Gladys Kalema	
Habinyanja	BB	M	Mizano	2011	Mugamizano in Bwindi 'neck'	?	Abdulhameed Kateregga	
Rushegura	ADF	F	Nyamunwa	2011	Hakondo	0792873/ 9890588	Fred Nizeyimana	Searched, but were unable to locate.
Oruzogo	INF	M	Kakobe twin	2012	Buhoma HQ; Gorilla Doctors	?	Mike Cranfield, Benard Ssebide, Abdulhameed Kateregga	
Solitary	SB	M	Unnamed	2013	Hakondo; near Repeater	0792686/ 9891064	Fred Nizeyimana	
Solitary	SB	M	Mutesi	2014	Kancherere	0793870/ 9892092	Fred Nizeyimana	Searched, but were unable to locate.
Mubare	INF	F	Mitunu's Inf	2015	Gorilla Doctors Cpd	Exact site known	Ricky Okwir, Benard Ssebide	

- **Clean, catalogue and inventory** newly recovered skeletal specimens.

- **Capacity Building** - Working with two UWA staff and two ITFC staff in all of the above activities, *continue* more targeted training in the following areas to build local expertise:
 - Training on skeletal anatomy/identification. Develop more detailed expertise of skeletal anatomy and biology through a more comprehensive short course in osteology.
 - Review the following protocols developed in Year 1, and target new knowledge development as needed:
 - Skeletal cleaning, labeling, inventory and cataloguing
 - Skeletal excavation protocols
 - Skeletal collections management practices
 - Continue introductions to selected research problems and techniques in skeletal biology.
- Offer a **1-2 day workshop for UWA and ITFC staff** in Ruhija and/or Buhoma (pending feedback from project partners), to provide introductory training on the following topics:
 - i. Objectives of the BINP skeletal project; what we can learn from preserving the skeletons of animals from BINP; value of these skeletons as a resource for research and education
 - ii. Skeletal identification; bones of the skeleton
 - iii. Protocols for handling a carcass discovered in the forest; protocols for burying a carcass.
 - If this workshop were to be located in Ruhija, it can include a visit to the skeletal collection.
 - We would request participation of experienced UWA (Vastine Tindimwebwa; Chance Joseph) and ITFC (Emmanuel Tibenda; Aventino Nkwasiwe) staff, as facilitators of the training.
- **One week based at ITFC-Ruhija** to assess condition of the skeletons after one year in storage, continue training and research activities.

Figure 1. Burial of ADF from Waterfall trail, Buhoma sector, marked at the surface with flowers. (BINP.045)



Figure 2. Excavation of ADF from Waterfall trail, Buhoma sector. (BINP.045)



Figure 3. Excavation of ADF from Waterfall trail, Buhoma sector – exposing the bones for removal. (BINP.045)



Figure 4. Skeleton of BINYONKO, ADF (BINP.046). Regions of the skeleton are fractured and impacted by erosion, due to overlying rocks and the extended burial time.



Figure 5. Skeleton of RUHONDEZA, ADM (BINP.042).



Figure 6. Skeleton of TWEHEYO, INF M (BINP.044), showing the immature skeletal status of this individual.



PROPOSED BURIAL PROTOCOL

Mountain Gorilla Skeletal Project

**Note, this is meant as a starting point for discussion; some procedures will likely need to be modified following input from MGVP and UWA and based on logistics.*

This document describes recommended procedures for the burial of mountain gorilla and other remains from Bwindi Impenetrable National Park to facilitate subsequent skeletal recovery. This protocol is **secondary** to all established UWA/MGVP biosecurity protocols, and may be modified in accordance with these protocols as necessary. All primate burials should be conducted under the direct supervision of UWA/MGVP veterinary staff, in accordance with their established biosecurity protocols for handling potentially bio-hazardous remains immediately post necropsy.

A. SUPPLIES:

- **Personnel protective equipment required by MGVP/UWA biosecurity protocols.**
- Paper label with individual ID and associated data in permanent ink
- Plastic ziplock bag for the label
- Mesh bags for hands and feet (of appropriate size)
- Tape measure to record burial shaft depth
- OPTIONAL: Digital camera to take photos of the burial

B. BURIAL PROCEDURES:

PREPARATION OF BURIAL SHAFT:

- (1) **The DEPTH OF THE BURIAL SHAFT should be four feet below the surface, measured from the bottom of the burial shaft.** (Deep burials take longer to skeletonize and they are very difficult to excavate.)
- (2) **The WIDTH and LENGTH of the burial shaft should be large enough to accommodate a carcass lying on its back, with arms and legs positioned to the sides of the body (i.e., not folded over the abdomen)**

PREPARATION OF REMAINS INSIDE THE BURIAL SHAFT:

- (1) **Internal organs should have already been removed from the thorax and abdomen at necropsy.** The organs should not be buried inside the carcass. Ideally, they would be buried in a separate hole. If necessary to bury the organs inside the same burial shaft, please place them to the side of the hole – away from the body.
- (2) **Do not bury the remains inside of a plastic bag.** Instead, the carcass should be buried directly in soil.
- (3) **Position the body to lie on its back at the bottom of the burial shaft.**

- (4) **Position the hands and feet apart from one another (i.e., not touching one another), and lying as flat as possible at the bottom of the burial.** This helps to maximize recovery of small hand and foot bones.
- (5) **OPTIONAL: Photograph the body inside the burial shaft.** Attach to the burial report.
- (6) **Cover the body with a few centimeters of soil, so that the remains are covered entirely.**
- (7) **Complete the attached label (page 4 of this document), and enclose inside of a ziplock bag, positioned so that the writing is legible. Place this label on top of the soil inside the crate.**
- (8) **Fill in the burial shaft with soil. Do not place large rocks in the burial shaft.** Instead, save these rocks for marking the burial at the surface.

C. MARKING THE BURIAL SITE

- (1) **Collect GPS coordinates of the burial location.**
- (2) **Place stones on the surface overlying the burial shaft.** Position the stones at all four corners of the burial shaft.
- (3) **Place a plaque or other marker at the head of the burial, located outside the burial stones.** This plaque should state the individual's name and date of death.



- (4) **OPTIONAL: Photograph the final burial site and surface marker(s).** Attach to burial report.

D. FORWARD A COPY OF THE BURIAL REPORT

- (1) **Complete the attached Burial Report (pages 5 and 6 of this document), and forward an electronic copy to the following people:**

UWA: Vastine Tindimwebwa?? Others?

MGVP: Fred Nizeyimana (fnizeyimana@gorilladoctors.org)

GWU: Shannon McFarlin (scmcfarlin@gmail.com)

Who else should be informed?

LABEL TO BE INCLUDED INSIDE THE BURIAL

Fill out the following information in permanent ink or ballpoint pen, place inside of a ziplock plastic bag, and place inside the burial on top of the remains.

INDIVIDUAL NAME:

MGVP ID NUMBER:

SPECIES:

DATE OF BURIAL:

PROSECUTOR(S):

NOTES:

**MOUNTAIN GORILLA SKELETAL PROJECT:
Burial Report**

INDIVIDUAL DATA

NAME:

MGVP ID NUMBER:

SPECIES:

SOCIAL GROUP:

SEX:

AGE:

DATE OF DEATH:

DATE OF NECROPSY:

DATE OF BURIAL:

CONDITION OF REMAINS WHEN FOUND (indicate preservation condition – skeletonized, advanced decomposition, fully fleshed):

LIST ANY BONES CUT and/or BONE SAMPLES COLLECTED AT NECROPSY:

BURIAL INFORMATION

- (1) Describe the exact location of the burial.

- (2) GPS Coordinates:

- (3) Describe any special circumstances or actions taken that are contrary to the burial protocol.

- (4) List the names of those present at the burial.

OPTIONAL PHOTOGRAPHS: May be included as time permits.

- (1) Condition of remains when found:

- (2) Photograph of the remains inside the burial shaft.:

(3) Photograph of the final burial location and surface marker(s):

(4) Any additional photographs of relevance:

SKELETAL CLEANING PROTOCOL: TERG-A-ZYME

Different cleaning strategies may be required for skeletal materials depending on their preservation condition and the presence of soft tissues. The main goal is to remove soft tissues (if present) and body fluid residues, excess fats, and any dirt or grime from bone/tooth surfaces that may pose biological hazards, attract insects or create other problems with long-term skeletal preservation. We want to do this as effectively but also as gently as possible, minimizing the potential for damage to the specimen, and also taking care to maximize the long-term preservation of the collection and its future research potential.

TERG-A-ZYME CLEANING OF EXCAVATED SKELETAL REMAINS

All skeletal remains are soaked in an enzymatic detergent solution, Terg-A-Zyme (produced by Alconox, Inc.), for cleaning. Terg-A-Zyme is a non-hazardous non-flammable substance, though it may be **irritating to skin, eyes and respiratory passages on contact**. (See the attached Material Safety Data Sheet).

Terg-A-Zyme is an enzyme-active detergent (see attached tech sheet and MSDS for ingredients) designed to remove soil and grime, proteinaceous soils, soft tissues, blood, body fluids, and other bio-residue, without damaging proteins that are bound to mineral in bone. It will also loosen fats that are located in the marrow cavity and spongy regions of bones. This is a more gentle cleaning strategy than boiling, bleaching or use of other chemical detergents, which can significantly degrade bone surfaces and lead to cracking over time.

Personal Protective Equipment (PPE):

For steps 1-3, below:

- **Latex / nitrile gloves**
- Recommended eye, nose and mouth protection to prevent splashes:
 - **N95 Mask**
 - **Safety glasses/Goggles**

Once remains have been allowed to dry, they should be handled with **latex or nitrile gloves**.

The following protocol is based on the condition of skeletal remains most typically encountered upon excavation:

- (1) **DAY 1:** Soak skeletal remains completely immersed in a large container filled with a 1% solution of Terg-A-Zyme. (This is equivalent to 10 grams of Terg-A-Zyme powder for every 1.0 liter of clean water.)
 - **Label the container with the individual ID/specimen number**, as labels marked directly on the bones wash away during the cleaning process.
 - **Take care to keep all bones and teeth belonging to one individual skeleton together, and separated from those belonging to other individuals.** Small grouped elements, such as left and right hands and feet, should be cleaned together in small containers (e.g., placed in separate mesh bags, and then soaked in the larger container with the rest of the skeleton), to facilitate sorting and identification later.
- (2) **DAY 2:** After 24 hours, replace with a fresh 1% Terg-A-Zyme solution (using clean water), and allow to soak for an additional 24 hours.
 - When transferring specimens from the first change of Terg-A-Zyme to the second change, you may use a soft toothbrush or sponge to *gently* brush the surface of the bones to remove soil and any additional residue from their surfaces.
- (3) **DAY 3:** Remove the skeleton from Terg-A-Zyme solution, and *rinse thoroughly* to remove all Terg-A-Zyme residue.
 - Set up two buckets of clean water for rinsing. As individual skeletal elements are removed, **rinse them individually and thoroughly in each change of rinse water** (i.e., they should be rinsed at least twice, until there is no residue). When cleaning large specimens, or multiple skeletons, make sure to change out the rinse water regularly, so that it does not become soapy.
 - **Use a strainer when pouring out old water**, to ensure that very small elements (e.g., finger bones, loose teeth, unfused epiphyses) are not lost.
- (4) If there is an infectious disease concern, Terg-A-Zyme cleaning may be followed by a soak in 10% bleach solution (with water) for 10 minutes. This must be followed by a thorough rinsing, with at least two changes of clean water (as above) for rinsing. (Note, this can be damaging to immature specimens, so extreme care must be taken to not let the specimens soak for too long).
- (5) **DAYS 3-5:** Lay the skeleton out on a drying rack in a shaded area, and allow to dry completely for at least 48 hours. Skeletons that are put away for storage without being allowed to dry completely are more prone to developing mold and other problems later.

- **Dry in the shade, never in the sun.** Leaving skeletons out in the sun for extended periods will lead to cracking.
 - **Drying time depends on specimen size and the weather conditions.** Large adults will take longer to dry than infant specimens, and skeletons dry more slowly in humid climates than in dry climates. Those regions of the skeleton that often take longer to dry include the ends of long bones, bones of the hands and feet, and other areas of the skeleton with a lot of marrow.
- (6) **DAY 5-6:** Once skeletal remains are completely dry, they may be put away for storage.

Additional Notes:

- (1) At minimum, a 1% solution must be used. However, the Terg-A-Zyme concentration may be increased slightly, depending on skeletal age, size and preservation. The concentration used isn't an exact science, and requires some experimentation to determine what works best for your specimens.
- A 1% solution is most appropriate for cleaning of very small or young infant/juvenile remains, specimens that have been buried (which may exhibit cracking, surface delamination, etc.), or for otherwise fragile specimens, irrespective of remaining soft tissues.
 - Where soft tissues are abundantly present and the skeleton is in otherwise good condition, you can start with a 5% Terg-A-Zyme solution until soft tissues are removed, and then reduce to 1% solution for final cleaning. Cleaning proceeds more slowly in a 1% solution, but this leaves the option to remove infant/juvenile specimens before unfused epiphyses become loosened. *Note: Soft tissues should not be present if appropriate excavation procedures were followed. Where they may be present on rare occasions, this would mostly likely be as tendons or ligaments, which are typically the last to decompose.*
- (2) The cleaning duration may be extended for difficult to clean specimens. The enzyme stops working after about two days, so more Terg-A-Zyme powder should be added to the water every other day (to restore a 1% solution). The water will also start to look yellow or cloudy if fat is being released from the bones, and changing out the water will speed the cleaning process. The water should be replaced with fresh water at least 1-2 times per week, depending on the specimen.
- Cleaning will also proceed more quickly in warm water, such as if the container is left in a warm place. (The ideal water temperature is 45° Celsius). However, do

not heat or boil the water on a stove.

- Remove when the skeleton is clean, and rinse thoroughly to remove any detergent residue. If there is any doubt, it is best to err on the side of caution:
 - i. Infant/juvenile skeletons: If left in detergent for extended periods of time, unfused long bone epiphyses may become loosened and lost, and there may be some flaking of the outer bone surface. These specimens should be watched carefully, and removed from the Terg-A-Zyme before this occurs.
 - ii. Bones that were previously buried and/or already exhibit some surface damage prior to cleaning should also be watched carefully, and removed from the detergent before additional damage occurs.
- (3) Terg-A-Zyme does a good amount of defatting/degreasing of bones. However, some fats may still remain within the marrow cavity of whole long bones, areas that may be inaccessible.

- distributors
- technical information
- free samples
- new developments



Tergazyme™ Enzyme-Active Powdered Detergent

- Concentrated to save you money
- Biodegradable and readily disposable
- Replaces corrosive acids and hazardous solvents
- Protease enzyme removes proteinaceous soils, tissue, blood and body fluids
- Free rinsing to give you reliable results and no interfering residues
- Use to pass your cleaning validation tests for lab accreditation and plant inspection approval

Used to clean: Hospital instruments, dairy equipment, laboratory ware, reverse osmosis and ultrafiltration membranes and units, sampling apparatus, pharmaceutical apparatus, cosmetics manufacturing equipment, tubing, pipes, optical parts, process equipment, industrial parts, desalination plants, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, blood, tissue, grease, fats, oils, proteinaceous soils, dairy proteins, particulates, solvents and bioreactor residue.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-in-place. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold or warm water. If available, use warm water below 130° F (55° C). Clean by soak, circulate, wipe, or ultrasonic method. Follow manufacturer's directions for filter membrane cleaning. Not for spray machines, will foam. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

Available in Convenient Sizes:

	Alconox Cat. #
Case 9 x 4 lb. Boxes	1304
25 lb. Carton	1325
50 lb. Carton	1350
100 lb. Drum	1301
300 lb. Drum	1303
250 x 1/2 oz. Box	1312

1 lb. makes 13 gal. cleaning solution



Tergazyme is available from leading laboratory, hospital, clinical and industrial suppliers. To find a distributor for Alconox, Inc. detergents, visit "Find Dealer" at the website. To request FREE samples, visit Sample Request at alconox.com, write or call Alconox, Inc. today.



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- distributors
- technical information
- free samples
- new developments

Fax Document #0413

Tergazyme Technical Bulletin

PHYSICAL DATA

pH of 1% solution
Flash Point (degrees F)
Phosphate Content (as Phosphorus)
Organic Carbon (1% calculated w/w)
Fragrance Content
Surface Tension 1% Sol'n (Dyne/cm)
Percent active ingredients

TYPICAL VALUE

9.5
None
7.5%
11%
0%
32
100%

Color: White and cream colored flakes and brown specks

Form: Powder

Solubility in Water: To 10% (w/w) at ambient temperature

Hard Water Effectiveness: Highly Effective

Biodegradability: Biodegradable

Foam Tendency: High Foaming

Shelf Life: Two years from the date of manufacture

Chemical Description

Tergazyme consists primarily of a homogeneous blend of sodium linear alkylaryl sulfonate, phosphates, carbonates, and protease enzyme. Tergazyme is anionic in nature. The protease enzyme in Tergazyme is bacillus licheniformis subtilisin carlsberg which may be deactivated by 300 ppm hypochlorite at 85 degrees F in seconds; 3.5 ppm hypochlorite at 100 degrees F for 2 min; exposure to pH below 4 for 30 min at 140 degrees F; or by heating to 175 degrees F for 10 min.

Cleaning Validation Methods:

Test a parameter of rinse water before and after rinsing the cleaned surface, or test the clean surface. No significant change in the parameter indicates no detectable detergent residue. Parameters measured include: pH, conductivity, UV, TOC, HPLC, sodium concentration, phosphorus concentration, anionic detergent concentration using inexpensive detergent water testing kits, surface tension, and surface analysis. For details see the Pharmaceutical Validation references at www.alconox.com

Health Safety Information:

OSHA Hazardous Ingredients: None

RCRA Hazard Class: Non-hazardous

Flammability: Non-flammable

Latex Content: None in detergent, packaging materials or adhesives.

Oral Toxicity: LD₅₀ > 5000 mg/kg oral rat. No ingredient defined as an oral toxicant by OSHA

Eye Irritation: Mild to Moderate eye irritant if not rinsed

Inhalation Toxicity: Non-irritating solution, powder a potential irritant

VOC Content: 0%

Carcinogenicity:

NTP = No IARC = No OSHA = No

All ingredients in Tergazyme are listed in TSCA inventory. USDA NSF cat A1

Precautions:

No special precautions other than good industrial hygiene and safety practices employed with any industrial chemical (see Directions). A Material Safety Data Sheet is available at www.alconox.com or by calling fax-on-demand at 914-948-4040 and following the prompts. Use fax document #0313.

Contact Alconox, Inc. for purchase specifications. Information presented is typical.

Typical data is not a specification.

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