

Filed on behalf of Bazooka-Farmstar, LLC

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAZOOKA-FARMSTAR, LLC,
Petitioner,

v.

NUHN INDUSTRIES LTD.,
Patent Owner.

Case IPR2024-00098
U.S. Patent No. 11,541,708

**PETITIONER'S UNOPPOSED MOTION TO FILE SUPPLEMENTAL
INFORMATION PURSUANT TO 37 C.F.R. § 42.123(a)**

Petitioner Bazooka-Farmstar, LLC (“Bazooka”) respectfully moves to file supplemental information relating to the ability of the vehicles described in the Truxor (EX1006) and SenwaTec (EX1012) prior art references to pump liquid manure, and confirming the public availability of EX1031. The Board authorized this motion on July 3, 2024. The supplemental information includes: a certified translation of the video of EX1031 (Ex. A), a German newspaper article with an accompanying certified translation (Exs. B-C), a magazine article (Ex. D), a journal article (Ex. E), the declaration of Eckhard Funck with an accompanying certified translation (Ex. F), and the declaration of Reinhard Speerschneider with an accompanying certified translation (Ex. G). *See* Exs. A-G attached hereto and proffered as the evidence to be filed if the motion is granted. The supplemental information meets the requirements of 37 C.F.R. § 42.123(a), will streamline the issues in this proceeding, and will not prejudice Patent Owner. Patent Owner does not oppose this motion.

Moreover, Petitioner filed similar requests for supplemental information in IPR2023-01161 (including attached Exs. A-E) and IPR2024-00004 (including attached Exs. F-G), both of which sought to introduce the same or similar evidence as is presented in the instant request, and both of which were granted by the Board.

I. BACKGROUND

Bazooka filed the Petition in this proceeding on November 3, 2023. Paper 2. Grounds 2 and 3 in the Petition relied in part on Truxor (EX1006) and SenwaTec (EX1012), each of which describe an amphibious dredging vehicle, to demonstrate the obviousness of claims 1, 8-18, 21-28, and 35-38 of U.S. Patent No. 11,541,708 (“the ’708 Patent”). *Id.* at 37-72. Bazooka filed publications (EX1055; EX1063) showing that dredging equipment, such as the dredging pumps of Truxor and SenwaTec, were known to be capable of pumping liquid manure. Bazooka also filed a German newspaper article with certified translation (EX1029-EX1030) and a video (EX1031), each of which depict the vehicle described in SenwaTec operating in manure.

The Board instituted this proceeding on all asserted grounds on May 23, 2024. Paper 10. In the Institution Decision, the Board noted that EX1029-EX1030 and EX1031 do not clearly disclose the type of material that the SenwaTec vehicle is pumping. *Id.* at 29. But the Board ultimately found that dredge pumps were known for pumping manure and that a POSA would have therefore understood the dredge pumps of Truxor and SenwaTec to be capable of pumping liquid manure. *Id.* at 29.

II. STATEMENT OF THE LAW

The moving party has the burden to show it is entitled to file supplemental information. 37 C.F.R. § 42.20(c); *Norman Int’l, Inc. v. Toti Testamentary Trust, et*

al., IPR2014-00283, Paper 29, at 6-7 (PTAB Sept. 29, 2014). This burden is met where: (1) a request for authorization to file this motion is made within one month of the date the trial was instituted; and (2) the supplemental information is relevant to a claim for which trial has been instituted. 37 C.F.R. § 42.123(a); *see Palo Alto Networks, Inc. v. Juniper Networks, Inc.*, IPR2013-00369, Paper 37, at 2 (PTAB Feb. 5, 2014).

III. BAZOOKA SHOULD BE ALLOWED TO FILE THE SUPPLEMENTAL INFORMATION

A. Both Prongs of 37 C.F.R. § 42.123(a) Are Met

Bazooka meets both requirements of 37 C.F.R. § 42.123(a). First, Bazooka requested authorization to file this motion within one month of the date the trial was instituted. Second, the supplemental information is relevant to a claim for which trial has been instituted (claim 1 of the '708 Patent) because the information: (1) is directed to a POSA's understanding of the capability of the dredging pumps described in the Truxor and SenwaTec references to pump liquid manure, and (2) reinforces the public availability of EX1031, which Patent Owner has put at issue in this proceeding. Paper 7 at 50-52.

Specifically, the certified translation of the video (Ex. A) of EX1031, shows that a POSA would have understood that the SenwaTec vehicle would have been capable of pumping lagoons filled with "thick slurr[ies]". *See, e.g.*, Ex. A, 6. Exs. B-

C, which are a newspaper and certified translation describing the SenwaTec vehicle, describe how the vehicle is used to pump “sewage slurry.” See, e.g., Ex. C, 1. Exs. D-E each separately describe how dredging pumps have been used to pump various forms of manure. Exs. F-G each separately describe the circumstances in which the video of EX1031 was shown and provide additional detail about the solid content and type of material pumped in the video. All this information is relevant to show that a POSA would have understood that the dredging pumps of the vehicles described by Truxor and SenwaTec would have been capable of pumping liquid manure. See *The Boeing Co. v. Seymour Levine*, IPR2015-01341, Paper 30, at 3-5 (PTAB April 15, 2016) (granting motion for supplemental information related to the “connectivity and removability [capabilities] of certain transmitters disclosed in the prior art references relied upon in the Petition.”).

B. The Board Should Grant Bazooka’s Motion

The supplemental information will streamline this proceeding by providing an accurate representation of the capabilities of the vehicles described in SenwaTec and Truxor and confirming the public accessibility of EX1031. It does not change the grounds of invalidity. See *Pac. Mkt. Int’l, LLC v. Ignite USA, LLC*, IPR2014-00561, Paper 23, at 4 (Dec. 2, 2014) (permitting supplemental information where the information “confirms the prima facie obviousness of claims [] as set forth in [the] petition.”). Furthermore, permitting the inclusion of the evidence at this stage

in the proceeding, as opposed to in the Petitioner’s Reply to Patent Owner’s Response, will provide Patent Owner with a greater opportunity to respond to the supplemental information and will allow the record to be developed more fully and efficiently. *See id.* This will further the Board’s mandate to “secure the just, speedy, and inexpensive resolution” of the proceeding. 37 C.F.R. § 42.1(b); *see The Boeing Co.*, IPR2015-01341, Paper 30, at 5.

Finally, Patent Owner will not be prejudiced by the introduction of this information in this proceeding. Patent Owner does not oppose this motion. Further, Patent Owner has been in possession of Exs. A-E since February 6, 2024, Ex. F since March 12, 2024, and Ex. G since May 13, 2024. “Given that Patent Owner already has possession of the supplemental information, there is little, if any, prejudice to Patent Owner if the information is allowed into the record.” *Palo Alto Networks, Inc.*, IPR2013-00369, Paper 37, at 5.

IV. CONCLUSION

Bazooka has satisfied both requirements of 37 C.F.R. § 42.123(a) with respect to its motion for supplemental information. Further, allowing this information at this stage will allow a more efficient and fulsome development of the record. For these reasons, Bazooka asks that the Board grant permission to file the supplemental information in this proceeding.

Respectfully submitted,

MERCHANT & GOULD P.C.

Date: July 15, 2024

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(Trial No. IPR2024-00098)

ATTORNEYS FOR PETITIONER

CERTIFICATION OF SERVICE

The undersigned certifies, in accordance with 37 C.F.R. § 42.6(e), that service was made on Counsel for Patent Owner as detailed below.

Date of service:	July 15, 2024
Manner of service:	Electronic mail addressed to: bluchsinger@harnessip.com syackey@harnessip.com mcutler@harnessip.com
Documents served:	Petitioner's Unopposed Motion to File Supplemental Information Pursuant to 37 C.F.R. § 42.123(a)
Persons served:	James B. Luchsinger HARNESS, DICKY & PIERCE P.L.C. 5445 Corporate Dr., Suite 200 Troy, MI 48098 Phone: 248-641-1600 Fax: 248-641-0270 bluchsinger@harnessip.com Scott E. Yackey HARNESS, DICKY & PIERCE, P.L.C. 2801 Network Blvd., Suite 600 Frisco, TX 75034 syackey@harnessip.com Matthew L. Cutler HARNESS, DICKY & PIERCE, P.L.C. 7700 Bonhomme, Suite 400 Clayton, MO 63105 mcutler@harnessip.com

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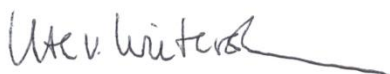
Translation Declaration

I, Ute von Wietersheim, do hereby declare as follows:

1. I certify that the attached translation from German to English is an accurate representation of the documents received by this office. The document is designated as: Video Screenshots.

2. Ute von Wietersheim, Translator of Questel-Orbit, Incorporated, attests to the following: "To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

3. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under the laws of the United States, including 18 U.S.C. § 1001.

Signature: 

Name: Ute von Wietersheim

Title: Translator, Questel-Orbit, Incorporated

Date: January 31, 2024



UD UMWELT-DIENSTE GmbH [This is the name of the company, literally translated it means UD ENVIRONMENTAL SERVICES LLC]



Efficient lagoon removal with amphibian removal technology

Agricultural utilization with quality and safety



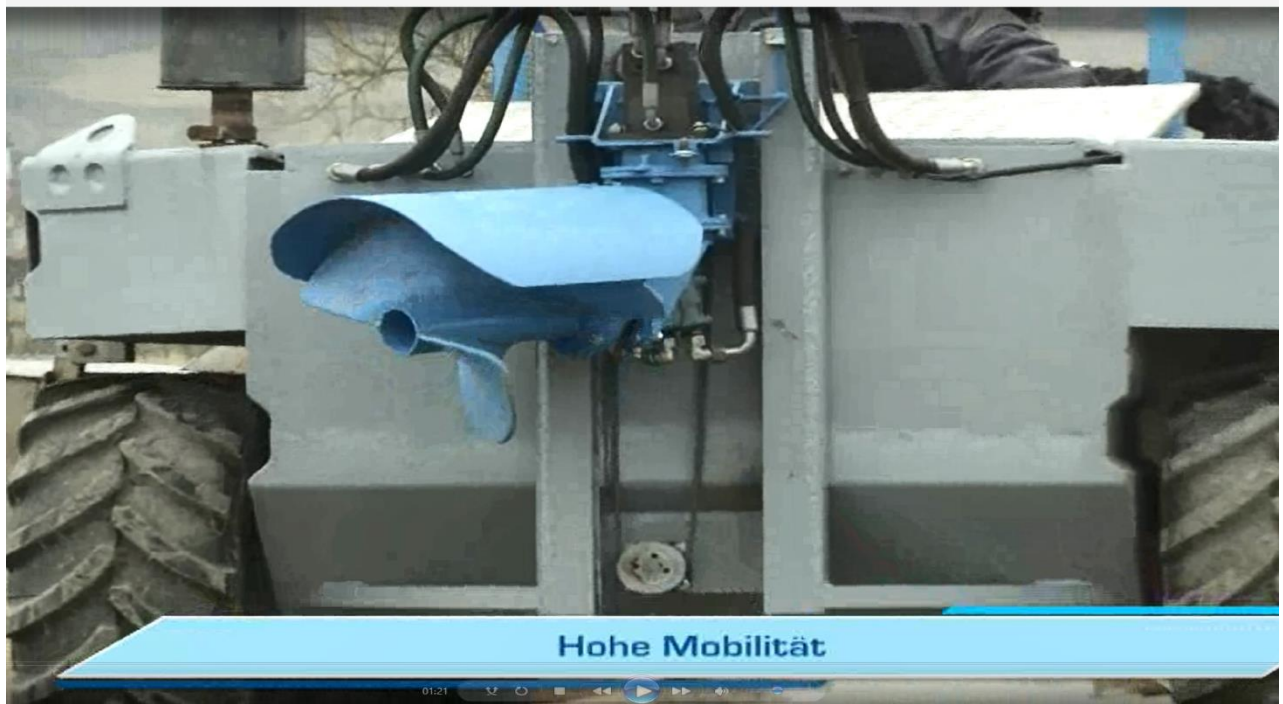
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76857 Rinnthal Phone: 0 63 46 / 92 81 40

info@umwelt-dienste.de www.umwelt-dienste.de



High mobility



UD UMWELT-DIENSTE GmbH [This is the name of the company, literally translated it means UD ENVIRONMENTAL SERVICES LLC]

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Liquefaction even of thick slurry



Homogenizing



Technology for slurry free of impurities



High performance pump technology



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High impact



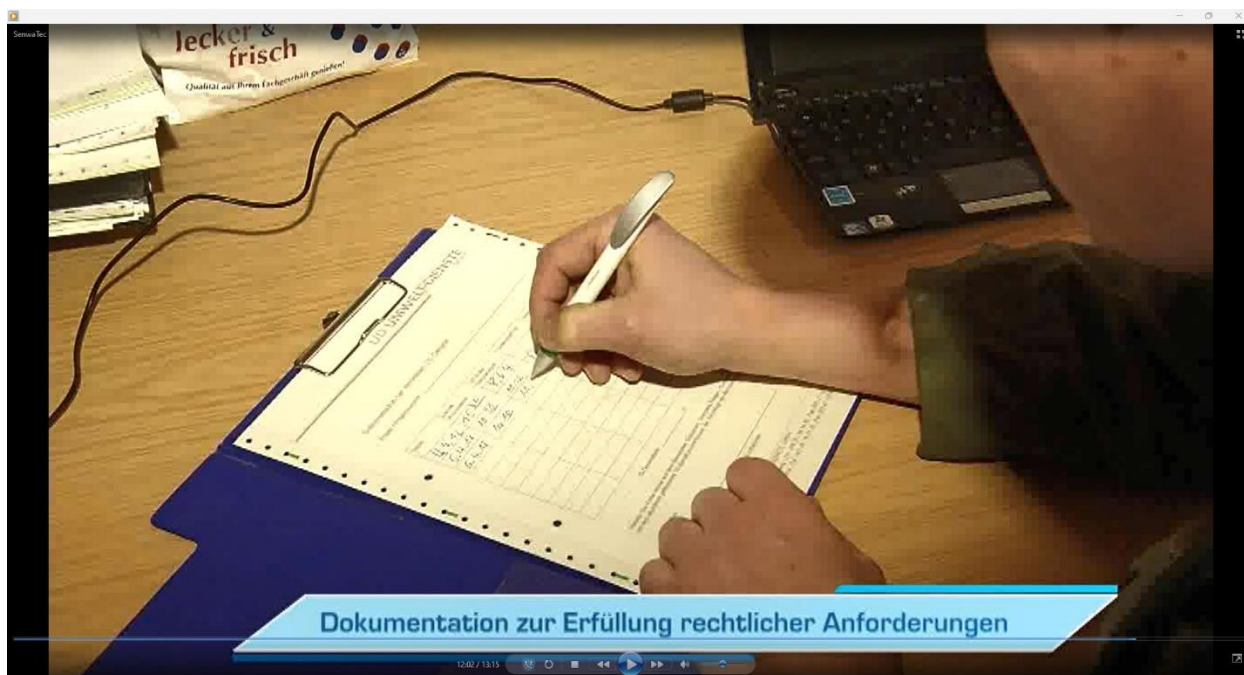
Need-based technology in different sizes



Utilization quality: determination of the TS-content



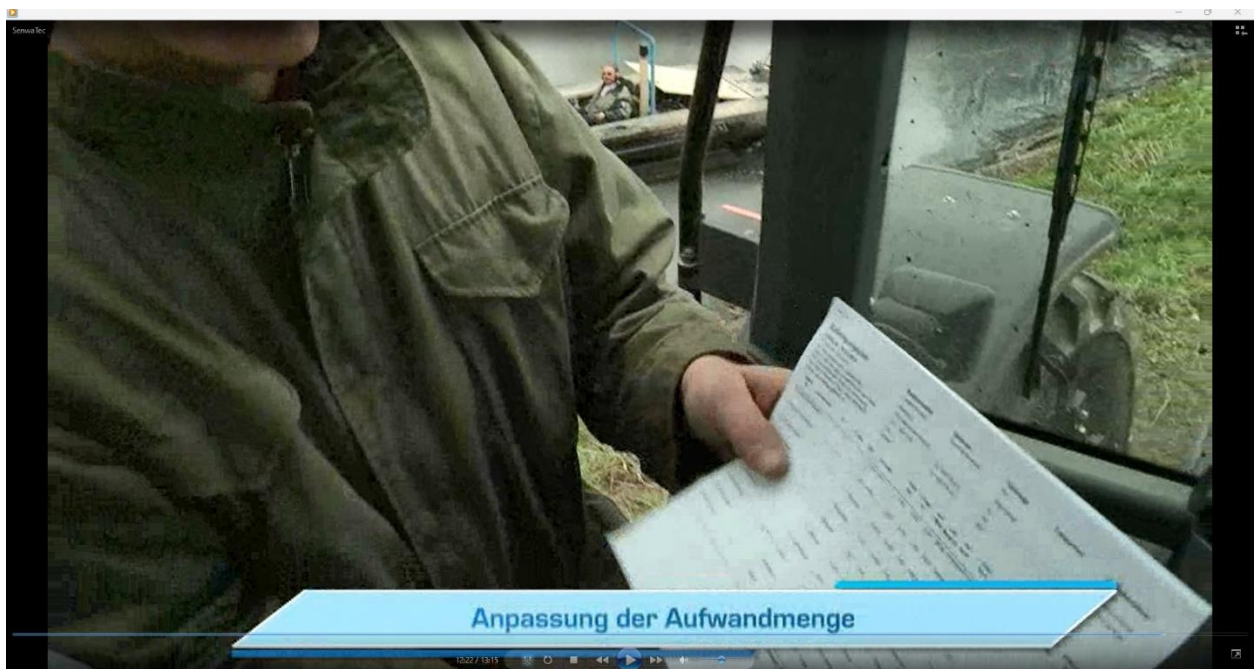
Documentation to meet legal requirements



Documentation to meet legal requirements



Daily collection sample



Adaptation of the quantity needed



Modern delivery technology



Successful work thanks to experience and know-how



UD UMWELT-DIENSTE GmbH [This is the name of the company, literally translated it means UD ENVIRONMENTAL SERVICES LLC]



The lagoon professionals

NEUBRUNN

Gequirilter Klärschlamm



Redaktion

15.10.2010 | aktualisiert: 15.10.2010 17:24 Uhr

(a) nk) In der Marktgemeinde Neubrunn mit Ortsteil Böttigheim wurde in den beiden Kläranlagen je ein Klärbecken gereinigt. Die Gemeinde beauftragte damit die Spezialfirma „DU Umweltdienste GmbH“ aus Rinnthal, die mit neuartigem Spezialgerät anrückte. Diese Firma ist eine Tochtergesellschaft des hessischen Bauernverbandes und seit fast 25 Jahren in der Klärschlammentsorgung tätig.



Foto: Andrea Kemmer | Aufwühlender Job: Eckhard Funck quirlt den Schlamm im Becken der Kläranlage Neubrunn mit seinem Amphibienfahrzeug auf, um ihn dann abzusaugen.

Mit seinen 80 PS starken Amphibienfahrzeug mit Auslegepumpe, welches in Neubrunn zum ersten Mal zum Einsatz kam, pflügte Eckhard Funck durch die schwarze Brühe. Dabei quirlte er mittels eines Aufwüblers an der Auslegepumpe und einer Schiffsschraube am Fahrzeugende sorgfältig Wasser und Schlamm. Je weniger Wasser im Teich ist, desto wichtiger ist das Umrühren, schließlich soll die ganze Angelegenheit schön flüssig bleiben. Dann kuppelte er einen Schlauch an die Auslegepumpe und beförderte den aufgewühlten Schlamm in das Transportfass an einem Bulldog. Dieser brachte den Klärschlamm auf landwirtschaftliche Flächen aus, wo er untergearbeitet wurde. Der Klärschlamm hat gute Düngewirkung.

Bevor der Klärschlamm jedoch auf landwirtschaftliche Flächen ausgebracht werden darf, müssen der Schlamm und auch der Boden sorgfältig auf ihre Werte untersucht werden. Wo der Schlamm bleibt, wie er verwertet und kontrolliert wird – all das muss die Firma dokumentieren und der Gemeinde vorlegen.

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VEITSHÖCHHEIM

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HAMMELBURG

Angst vor Wasser und Höhe: Trotzdem tritt der Hammelburger Matthias Mangiapane beim RTL-Turmspringen 2025 an

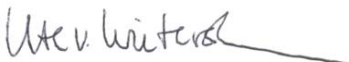
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Signature: 

Name: Ute von Wietersheim

Title: Translator, Questel-Orbit, Incorporated

Date: 1/27/2024

NEUBRUNN

Agitated Sewage Slurry



From the Editor

Oct. 15, 2010 | Updated: Oct. 15, 2010 05:24 PM

(a) nk) In the municipality of Neubrunn with the commune of Böttingheim, one basin was cleaned in each of the two sewage treatment plants. The municipality had hired the specialist company “DU Umweltdienste GmbH” from Rinnthal, which arrived with a new type of special equipment. This company is a subsidiary of the Hessian Farmers' Association and has been active in sewage slurry disposal for almost 25 years.



Photo: Andrea Kemmer | A stirring job: Eckhard Funk agitates the sewage slurry in the basin of the Neubrunn sewage treatment plant with his amphibious vehicle and then sucks it out.

Eckhard Funk plowed through the black slurry with his 80 hp amphibious vehicle with a boom pump, which was used in Neubrunn for the first time. He carefully agitated the water and the slurry using an impeller on the boom pump and a propeller at the end of the vehicle. The less water there is in the basin, the more important it is to stir it up - after all, the whole thing has to stay as smooth and liquid as possible. Then, he connected a hose to the boom pump and transported the agitated slurry into the transport barrel on a tractor. This tractor then spread the slurry on agricultural land where it was worked into the soil, since sewage slurry has good fertilizing properties.

Before the slurry can be spread on agricultural land, however, the slurry and the soil must be carefully tested and analyzed. The company has to document and present its findings to the municipality in a report that states where the slurry was spread, how it is being used, and what control mechanisms are in place.

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HAMMELBURG

**Afraid of water and heights: How
Hammelburg's Matthias Mangiapane
is still competing in the 2025 HTL-High
Dive Competition**

Custom Applicator Uses Dredge To Pump Lagoons

Custom manure applicator Eric Dresbach has a specialty that keeps him in high demand. He uses a dredge to get to the bottom of lagoons and open pits, pumping up the sludge and sand that can reduce a lagoon's volume. For Dresbach, the dredge is a moneymaker and a business-building tool.

"Dairy lagoons especially tend to lose capacity over time because the solids are so difficult to remove," says Dresbach. "The only way to do it has been to pump out the liquids and then break a wall and bring in a bulldozer or big tractor. It's a sloppy, expensive job. I can use my dredge to pump the sand and sludge into a tank or sand separator and then spread the sludge on fields."

Land application of manure and other biosolids is a good business for Dresbach, who started out hauling grain and switched to biosolids. His slogan in manure application is, "If it smells, we knife it in." He points out that manure is a resource that only has value in the ground. Odor in the air means nutrients are going to waste. That odor is also likely to bother friends and neighbors living around the farm site or spreading area. Keeping down odor satisfies customers and helps build his business.

"In the same way, when you use a pump to aerate a lagoon to get the sludge into solution for pumping, you put odor into the air," says Dresbach. "The dredge helps us conserve nutrients and protect the environment."

The pontoon boat is outfitted with a cutterhead that operates at variable speeds and a 1,000-gal. per min. pump. A gripper winch on up to 1,000 ft. of cable pulls the dredge across the lagoon as it works. Dresbach controls the speed of the winch, the depth and speed of the cutterhead and the speed of the pump mounted behind the head.

"We can operate 15 ft. below the water surface and take out a more uniform product," says Dresbach. "I put the cutter head into the sludge and can physically see the product as we are pumping it. I can dial the speed up or down to make it as thick as we want."

Dresbach says every livestock situation is different. While dairy sludge is heavy and often has a high sand content, hog manure solids are light and fluffy and easier to pump. Working with the sledge has been a learning experience and one he has had to do on his own. While similar dredges are used in industrial settings, they are rare in agriculture.

"To my knowledge, I am the only operator in Ohio using a dredge in manure lagoons," says Dresbach.

The dredge is only one of his tools. He has four JCB tractors rigged with 7,300-gal. honey wagons and 9-shank toolbar applicators for injecting manure. He uses a large tank for primary pumping. Five semi-trailers transport manure from the tank to the honey wagons in the field. He also uses three tractors for lagoon pumping and doing applications, as well as three trash pumps for pulling stored manure out from under hog barns.

"Our goal is to move at least 200,000 gal. of manure per day," says Dresbach. "We pull manure samples every hour as the manure is being loaded to let customers know exactly what nutrient levels are being spread," says Dresbach. "That lets them adjust their fertility program as needed."

In addition to his land application business, Dresbach consults with livestock producers in the design, construction, renovation and operation of manure lagoons. He also consults with new custom manure applicators on business entrepreneurship, operations and growing their



business.

Contact: FARM SHOW Followup, W D Farms Inc., 22058 Bolender Pontius Rd., Circleville, Ohio 43113 (ph 740 474-1618, cell 740 412-7356; shdresbach@ bright.net).

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CLOSURE OF EARTHEN MANURE STRUCTURES (INCLUDING BASINS, HOLDING PONDS AND LAGOONS)

**Don D. Jones¹, Richard K. Koelsch², Saqib Mukhtar³,
Ronald E. Sheffield⁴, John W. Worley⁵**

ABSTRACT

This paper is a summary of what is known scientifically about the closure of earthen manure structures without artificial liners, including lagoons, storage basins, and runoff holding ponds, and what needs to be examined further to increase our understanding of the dynamics of closing them in an environmentally safe manner. This information should be useful as a guide for state regulatory agencies considering rules for closure and for academicians and consultants who work with live-stock production facilities.

Keywords: *Lagoons, Manure storage, Earthen storages, Seepage, Closure, Groundwater contamination.*

INTRODUCTION

When a livestock production unit ceases operation, proper procedures need to be undertaken to properly close earthen manure structures without artificial liners (including lagoons, storage basins, and runoff holding ponds), in order to assure protection of surface and ground water. There are three primary environmental risks associated with such earthen structures: nutrients and pathogens, which can be a concern for both surface and ground water quality, and degradable organic matter, which is a concern for surface water due to runoff from structure overflow during the closure process or from land application of the contents.

Earthen manure structures, properly designed, installed and operated according to accepted engineering standards (such as those defined by USDA-NRCS *Agricultural Waste Management Field Handbook* and ASAE Standard EP393.2, “Manure Storage,” and ANSI/ASAE EP403.2, “Design of Anaerobic Lagoons for Animal Waste Management”), should pose little risk to water quality. A well maintained earthen structure should show:

- Limited erosion of sidewalls due to wave action,
- Lack of erosion in the vicinity of a manure inlet pipe,
- Lack of erosion near areas used for contents agitation and removal,
- Well maintained sod on berms and exterior sidewalls (weed and tree growth controlled),
- No signs of burrowing animals in or around the berms or sidewalls, and
- Lack of seepage around pipes through the sidewall and along the toe of the berm.

The addition of manure to an earthen structure further reduces seepage rates due to physical, chemical, and biological processes that contribute to the clogging of soil pores. The NRCS *Animal Waste Management Field Handbook (1992)* acknowledges a reduction in the coefficient of permeability by a factor of at least 10. This suggests that, for a properly designed and constructed facility, maintaining an intact structure and liner after abandonment should be an environmentally sound practice to protect against seepage. However, this may or may not be considered environmentally sound for other reasons, e.g., if the structure is allowed to overflow.

Poorly designed or poorly constructed earthen liners, as well as badly eroded ones, can allow significant movement of contaminants into the soil adjacent to or below the structure before the time

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time of closure. Soil borings may be necessary to accurately assess the movement of nutrients below inadequate earthen structures at the time of closure and to determine the proper procedures necessary for closure.

This White Paper will examine what is known about closing earthen manure structures without artificial liners (such as lagoons, storage basins, and runoff holding ponds) and what needs to be examined further to increase our understanding of the dynamics of closing them in an environmentally safe manner. It will first provide the authors' general recommendations for closure, and then review the methods available for removing the contents of the structure and discuss in more detail the options for closure or alternative uses of the site. It also includes a literature review of water quality risks and identifies areas where further research is needed.

GENERAL CLOSURE RECOMMENDATIONS

Based on a review of available literature and the professional judgment of the authors, several fundamental principles should be applied to the abandonment of earthen manure structures, without artificial liners, that were reasonably well designed and constructed, and properly maintained during their useful life.

The preparation of an earthen manure structure for closure involves three critical principles:

1. Protection during the closure process of the soil/organic matter interface layer that forms a relatively impermeable natural liner around the structure contents.
2. Removal of all liquids and pumpable slurry.
3. Land application of removed liquids and sludge at agronomic rates.

After liquids and sludge are removed and utilized in an environmentally sound manner, there are four generally acceptable options for completing the closure process. Check with local and state regulatory agencies since the closure of earthen manure structures is sometimes governed by specific state or local regulations. In some states, the producer is required to complete a closure report. Generally acceptable options for closure of an earthen manure storage include:

Option A: Permanent elimination of an earthen manure structure.

- Diversion of all surface water away from storage site;
- Filling of the storage structure with soil to a mounded surface that sheds rainwater;
- Establishment of a growing crop or sod.

Option B: Permanent conversion to a fresh water pond.

- Establishment of a maximum water level;
- Rinsing of the storage structure several times, with irrigation of the contents onto cropland;
- Refilling storage with fresh water.

Option C: Breaching of the berm.

- Diversion of all surface water away from the storage site;
- Breaching of the berm;
- Establishment of a growing crop or sod on the bottom and sides of the structure.

Option D: Managing earthen manure structures at temporarily depopulated operations.

- Preventing overflow from the structure;
- Minimizing runoff of contaminated material into the structure.

The procedures outlined here assume that the liner has been adequately protected from erosion and other threats to liner integrity. If these assumptions are not correct, soil borings are needed to determine if a more extensive cleanup is required. Regardless of the intended end use, all conveyances (pipes and ditches) used to convey manure to the basin should be removed and replaced with compacted soil. A more complete explanation of each of these principles is given later in this paper.

PRINCIPLES OF PREPARING EARTHEN MANURE STRUCTURES FOR CLOSURE

Protecting the Integrity of the Existing Earthen Liner During Closure

No matter which closure method is chosen, maintaining an intact liner is likely less of a danger to the environment than attempting its removal. As much sludge and solids should be removed from the basin as can be accomplished without endangering the integrity of the liner. In the event of poor

liner design, construction, or management, or where the liner has been damaged, nitrogen movement may be found in soil borings beneath the storage. In these cases, removal of several inches of the soil liner may be necessary. However, this should be the exception rather than the rule, and a knowledgeable consultant should determine the need for such measures after soil borings and inspection.

Sludge Sampling

Sheffield et al. (2000) states that measuring and sampling sludge should be done from a boat. For safety reasons, at least three people should be present: two in the boat and one on the lagoon bank. The extra person on the boat assists with entering and exiting the boat, and the extra person(s) on shore may be needed as a rescuer(s), should anything go awry. Flat-bottom boats are recommended over canoes or V-bottom boats. Everyone in the boat should wear appropriate flotation devices.

Sheffield et al. (2000) recommends measuring the amount of sludge and solids in a lagoon by lowering a lightweight, rigid, 1.27 to 2.54 cm diameter (0.5 to 1 inch) wooden or capped aluminum pole slowly into the lagoon until the liquid seems to become denser and thicker. Record the water level on the pole and continue to push the pole down until you feel you have reached the bottom of the lagoon. Again, record the water level on the rod, and remove it from the lagoon. The difference between the readings is the depth of the sludge and solids. Commercially available sludge samplers are useful for collecting samples, but do not work well for estimating sludge volume because of the density of anaerobic lagoon sludge. The sludge layer in a lagoon is a “mobile” fluid that forms peaks and valleys within the lagoon. Sheffield et al. (2000) recommends that at least 10 depth measurements be taken randomly. For a more detailed assessment of sludge volume, a formal grid should be established over the surface of the structure. US EPA recommends at least 4 grids per cell with no grids larger than 930 cu m (10,000 sq ft). Plot depth measurements at grid points to develop a contour map of sludge deposits on the bottom of the storage to estimate the amount of sludge and solids beneath the liquid.

Sheffield et al. (2000) also states that the best time to take a sludge sample is while measuring for volume of sludge in a lagoon. This allows samples to be collected from several points around the interior of the lagoon. Depending on density and nutrient concentration, the samples may differ by as much as 100% from point to point. To draw a sample, insert a 1.3 to 1.9 cm diameter (0.5 to 0.75 inch) PVC pipe into the lagoon sludge until the pipe reaches the bottom. Wearing plastic or latex gloves, cap the end of the pipe to create a vacuum and slowly withdraw it from the lagoon. This will capture a core or profile of lagoon effluent and sludge. Once the pipe outlet is over a clean container, slowly break the vacuum and allow it to drain. Place several samples in the container and mix thoroughly. Use a plastic, wide-mouth bottle and follow laboratory instructions when shipping samples for analysis.

Removal of Liquids, Pumpable Sludge and Solids

Removing sludge and solids from earthen manure structures can be accomplished by several methods:

- Agitate and remove the combined contents of the structure and land-apply.
- Remove and land-apply liquids; agitate, remove and land-apply sludge.
- Remove and land-apply liquids; dredge and land-apply sludge.
- Agitate and remove the structure contents, concentrate and remove solids, and land-apply.
- Use a sludge dredge and land-apply without dewatering.

Agitate the Combined Contents of the Structure and Land-Apply

In this method, liquid and sludge are mixed with an agitator or a chopper-agitator impeller pump. High-volume pumps (11,500 to 19,000 liters per minute; 3,000 to 5,000 gallons per minute) specifically designed for agitation and loading provide for suspension of solids. However, agitation equipment is generally only effective in suspending solids within about 15 m (50 feet) of the agitator. Because agitation equipment can erode earthen liners near the agitator, it should be used cautiously. Direct the agitation flow away from the liner and keep the agitation unit at least three feet away from the soil surface. The mixed contents can be pumped through a large-bore sprinkler irrigation system onto nearby cropland. At many sites, the removed material should be soil-incorporated to minimize odor, nitrogen volatilization, and runoff potential.

Remove and Land-Apply Liquids; Agitate, Remove and Land-Apply Sludge

The liquid portion of the earthen structure is dewatered by irrigation onto nearby cropland or forage-land. The remaining sludge is then agitated and pumped into a sludge applicator. The sludge can be spread onto cropland or forage land or soil-incorporated. This method may not work as well with dairy manure due to its fibrous nature, larger particle sizes and higher solids contents, compared to swine and poultry manure structures. After the liquid and most of the sludge is removed, depending on the condition of the liner, it may be necessary to remove any remaining solids with a small track-type dozer or farm tractor with a bucket.

Remove and Land-Apply Liquids, Dredge and Land-Apply Sludge

The earthen structure is dewatered by irrigation onto nearby cropland or forage land. Sludge is then removed with a dragline or sludge dredge (Figure 1). Note that the dragline must be used very cautiously to avoid damage to the organic liner. With more fibrous manure, it may be practical to establish a gently sloping bermed area beside the structure to receive the dredged sludge and allow liquids to drain back into the earthen structure to provide additional dewatering. This may not be feasible with swine or other non-fibrous sludge that does not stack well. After air-drying to produce a semisolid or solid material, the sludge is hauled and spread with a solid manure equipment onto cropland or forage-land at agronomic rates. Soil-incorporation should be used where feasible to better retain and utilize the nutrients in the sludge.

When removing sludge, the pumper or dragline operator must pay close attention to protect the organic liner. Any damage may not be noticeable until the liquid level drops. If the soil liner is disturbed, stop the activity immediately and do not continue until operations are modified to prevent further damage. A damaged liner should be repaired with suitable soil material as soon as possible.

Agitate and Remove the Structure Contents, Concentrate and Remove Solids, and Land-apply

The entire contents of the manure structure is thoroughly agitated and removed. Solids are separated from the mixture of sludge and liquid and the liquid is land-applied. The solids are land-applied, composed or otherwise utilized. (See later section on Sludge Reduction Alternatives.)

Use of Sludge Dredge and Land-Apply without Dewatering

Pumping dredges are commonly used to remove solids from municipal and industrial wastewater lagoons and holding ponds. A pumping dredges is typically a floating barge with a variable-depth-pumping head to remove sludge from the bottom of the structure (Figure 1). Power units can either be located on the barge or may be hydraulically operated pumping heads with power units located on the berm.



Figure 1. Pumping dredge operating in a lagoon in North Carolina.

A higher concentration of solids can be removed from a lagoon with the sludge dredge because sludge is removed without agitation or dilution, thus reducing transportation cost. With the assistance of guide cables, dredges work back and forth across a lagoon, working their way down the earthen structure, until the solids are removed. Since the dredges do not use aggressive agitation or cleaning nozzles, equipment manufacturers and operators claim that pumping dredges do not negatively impact the condition of earthen liners.

Pumping dredges are best suited for large structures or where large amounts of solids must be removed. Because of their size and weight, dredges may be placed into and removed from an earthen structure with a crane.

Sludge Reduction Alternatives

Chastain and Darby (2000) studied a thickening process for lowering the cost of removing sludge from a dairy lagoon. By settling sludge from mixtures of sludge and water (1.93 and 3.99% total solids) for 7 hours and draining the supernatant back to the lagoon, the volume of sludge was reduced by an average of 60%.

Several companies offer various lagoon additives intended to reduce the volume of sludge in anaerobic lagoons. These products provide a mix of various microorganisms, enzymes, proteins, or catalysts to stimulate the microbial degradation of accumulated sludge. The Animal and Poultry Waste Management Center at North Carolina State University has evaluated several of these products since 1997. To date, these studies have been unable to verify significant reductions in sludge volume. This may be due to differences in dosage of product, method of application, or type of operation where the products were tested.

Anecdotal information from producers in the Midwest, however, continues to indicate that some of these products may be effective. Some producers have used baker's yeast effectively to suspend solids by spreading 120 gm/L of fresh baker's yeast mixed (1 lb/gal) of lukewarm water (32-38 C° [90-100°F]) at a rate of one L per 1.84 sq m (1 gal/75 sq ft) of liquid surface with the storage agitated and pumped after two weeks later (Sheffield et al, 2000).

Estimated Cost of Liquid and Sludge Removal

The cost of closing an earthen manure structure is often a concern. In many cases, the operation is closing because of financial difficulties and there are simply no funds remaining to properly close the manure structures. Some states have handled this issue at the time the storage is initially approved by requiring a bond to be posted to cover all or part of closure costs. According to the Environmental Review Commission of the North Carolina General Assembly (2000), Oklahoma, Iowa and Missouri already have legal mechanisms in place to ensure that owners have the funding available for lagoon closure and have legislation that holds producers responsible for closing facilities through one-time fees, annual fees and financial sureties (statement of assets, irrevocable letter of credit, cash or cashier's check).

In 2000, the North Carolina Department of Environmental and Natural Resources (DENR) reported there were 1142 inactive lagoons on 745 farms and that 39 were considered high risk. They assigned 93% of the inactive lagoons a medium risk (requiring further study) because of the uncertainty over the behavior of nutrients contained in inactive lagoons and limited data regarding groundwater levels and surface water contamination. The primary source of pollutants in inactive lagoons was assumed to be the sludge because of high N and P levels. Using NRCS standards for lagoon closure, DENR estimated the cost of closure at \$105,000/hectare (\$42,000/acre), or \$30,000,000 to close all inactive lagoons in the state. Actual closure costs in North Carolina were between \$1.32 and \$8.47 per cu m (\$5 and \$32/1000 gal) of waste removed, according to the Environmental Review Commission of the North Carolina General Assembly (2000). The estimated closure costs for a 3,785 cu m (1,000,000 cu ft) lagoon would thus range from \$5000 to \$32,000. This is high enough that producers cannot be expected to voluntarily close their inactive lagoons.

Lindemann et al. (1985) studied sludge removal from three dairy lagoons. A tractor-PTO propeller agitator, a two-stage portable solids handling and irrigation pump worked well to remove high-solids sludge from both dairy and poultry lagoons. The nutrient value of the sludge was sufficient to offset 30 to 50% of the cost of pumping.

Hiring a custom applicator is often a feasible method of managing sludge. The high cost of sludge removal equipment is prohibitive for most producers, especially due to the infrequency of

sludge removal. Also, many lagoons can accumulate sludge for up to 10 years or more before their treatment ability declines. The cost of hiring a contractor is largely based on the amount of sludge to be removed. A 1999 survey of custom applicators in eastern North Carolina (Sheffield et al, 2000) showed that prices ranged from 0.4 to 1.3 cents per liter of sludge (1.5 - 5.0 cents/gal) of sludge. The difference in cost depended on the size of lagoon to be pumped, lagoon accessibility, distance to available application sites, and whether the sludge was to be irrigated, broadcast, or injected.

Land Application of Liquid and Sludge at Agronomic Rates

Material removed from the bottom of the storage will have significant quantities of nutrients. Producers should obtain a nutrient analysis, estimate the proper application rate based on soil tests and crops to be grown on the application site, and monitor the actual application rate. The accumulation of phosphorus in the sludge commonly determines the minimum land requirement, based on agronomic needs of crops. For this reason, nutrient management plans should consider that all P added to the structure is available for land application eventually, and not underestimate life cycle land area requirements.

Factors influencing land area required to apply sludge during closure:

- Nutrient analysis of sludge,
- Nutrient analysis of supernatant,
- Crop to be grown,
- Soil type,
- Soil fertility level (Phosphorus),
- Local/State regulations, and
- Application method.

The application rate should not exceed the annual crop nitrogen requirements (consult your local NRCS or your local land grant university Extension Service for assistance in determining recommended land application rates in your location). Tables 1 and 2 can be used to determine land

Table 1. Estimate of phosphorus removal by various crops.

Crop	P ₂ O ₅ Removal per Unit of Crop Yield*	Estimated Crop Yield Kg/ hectare (bu or tons per acre)	P to be Supplied for ? Years (3 to 5 years suggested)	P ₂ O ₅ Application Rate Kg/Hectare** (lb/acre)
Example: Grain corn	6.25 g/Kg × (0.35 lb/bu) ×	9,535 × (150) ×	3 =	179 Kg/hectare (160 lb/acre)
Corn (grain)	6.25 g/Kg × (0.35 lb/bu) ×	× ×	=	
Corn silage	6.25 g/Kg × (3.5 lb/ton) ×	× ×	=	
Sorghum (grain)	6.25 g/Kg × (0.35 lb/bu.) ×	× ×	=	
Wheat	22.5 g/Kg × (1.35 lb/bu) ×	× ×	=	
Alfalfa	5 to 12.5 g/Kg × (10 to 25.0 lb/ton) ×	× ×	=	
Most grasses	12.5 to 15 g/Kg × (25 to 30 lb/ton) ×	× ×	=	
Bermuda hay	57.5 g/Kg × (115 lb/ton) ×	× ×	=	
Soybeans	13.3 g/Kg × (0.8 lb/bu) ×	× ×	=	
* Phosphorous removal rates may vary by climate and region in U.S. Consult your local CES, NRCS or crop consultant for accepted local values. ** Grams converted to kilograms.				

Table 2. Estimate of land requirements for sludge or slurry application at phosphorus removal rate.*

Source of Nutrients	Total P ₂ O ₅ in Sludge & Solids (from Table 6)	Portion Removed from Storage (between 0 and 1)	Desired P ₂ O ₅ Application Rate (from Table 1)	Application Area Needed hectares (acres)
Example: Swine lagoon sludge from 10 yr. accumulation	61,200 Kg (135,000 lb) ×	0.5 ÷	179 Kg/hectare (160 lb/acre) =	172 hectares (422 acres)
	×	÷	=	
	×	÷		
* The application rate should not exceed the annual crop nitrogen requirements. Note that the portion removed would approach 1.0 if the storage is being emptied for closure, assuming that no sludge had been removed during the 10 years of accumulation.				

requirements, assuming that sludge is applied to meet crop phosphorus needs. These tables are based on phosphorous removal rates from the soil—not crop growth recommendations. Producers should check soil phosphorus levels at the application site for the next several years to determine when commercial phosphorus application is needed.

Application sites should be evaluated for their current soil phosphorous level and risk of runoff or erosion contaminating surface water. State regulations and best management practices should be followed in selecting suitable land application sites.

Specific Earthen Manure Storage Closure Procedures

Option A. Permanent Elimination of Earthen Storage Structure

1. Divert all surface water runoff away from the storage. This includes runoff from building roofs, abandoned feedlots, and cropland.
2. Remove any pipes and structures adding runoff or manure to the storage.
3. Remove all liquid, pumpable sludge and solids. Refer to dewatering procedures discussed earlier for details.
4. Fill the structure with soil. Fill with soil by pushing in existing dams or berms and bringing in additional fill as needed. The backfill height should exceed the design finished grade by five percent to allow for settlement. The degree of compaction required for backfill material will depend on the anticipated future use of the site. For example, a higher compaction would be needed for building construction than for animal pasture or cropland. The degree of compaction must be sufficient that settlement does not create a depression that collects rainwater (NRCS, 2000).
5. Establish a crop cover or sod. The final surface should be tilled and a vegetation cover established to minimize soil erosion. A crop with a deep root zone such as alfalfa is preferred because of its ability to harvest remaining nutrients.

Option B. Permanent Conversion to a Fresh Water Pond

1. Set maximum water level. An overflow spillway (if one does not currently exist) or a stand-pipe should be added to set a maximum water level at least 0.3 m (12 in) below the lowest point in the berm or dam. A Professional Engineer should be consulted to design an adequate overflow.
2. Remove any pipes and structures adding runoff or manure to the storage.
3. Remove all liquid, pumpable sludge and solids. Refer to dewatering procedures discussed earlier for details.
4. Rinse the structure with water. The lagoon should be refilled with water after pumping all sludge and liquid, and allowed to sit for several months. During the next growing season the lagoon should be agitated and completely emptied and its contents applied based upon crop water needs. Nutrient concentration should be very low by this time and should be a factor in determining application rate.
5. Refill structure with water. The dissolved oxygen (DO) concentration should be checked after the second refill. If levels are less than 3 mg/liter, continue the rinsing (fill and dewater) cy-

cles. If DO levels are 3 mg/liter or higher, the earthen structure can be managed as a farm pond. Alternatively, available nitrogen levels can be checked and rinsing continued until available nitrogen levels as measured by a laboratory or a nitrogen meter are less than 10 mg nitrate-N/liter. Clean runoff or other fresh water should be added to the lagoon to maintain the pond near capacity. A high water level is helpful to minimize liner degradation due to desiccation, burrowing animals and vegetation growth. Water from the unit should not be used for livestock consumption without first testing for pathogens and nitrate levels, and consultation with your veterinarian.

Option C. Breaching the Berm

1. Divert all surface water runoff away from the structure. This includes runoff from building roofs, abandoned feedlots, and cropland.
2. Remove any pipes and structures adding runoff or wastewater to the structure.
3. Remove all liquid, pumpable sludge and solids. Refer to dewatering procedures discussed earlier for details.
4. Breach the berm. After removing as much liquid and sludge as possible, allow the remaining solids to dry. If more than about 12 inches of solids remain after pumping, remove them while making every effort to maintain liner integrity. Ideally, paved pads should have been installed at the agitation points at the time of construction. If this was not done, make sure the agitator directs its flow away from the liner and keep the agitator at least three feet away from the liner. The remaining solids can be removed by agitating and removing contents at a time when climatic conditions are favorable for drying the remaining solids sufficiently for removal with earth-moving equipment. Alternatively, settled material can often be removed by refilling with water, agitating, and emptying again and again, until most solids are removed. A section of the existing lagoon berm or dam should then be removed. The breach should be low enough on the slope of the dam to allow any water that enters the structure to quickly drain away.
5. Establish a growing crop or sod. The final surface should be tilled and planted with vegetation to minimize soil erosion and extract nutrients.

Option D. Managing Manure Storages at Temporarily Depopulated Operations

Livestock facilities are sometimes depopulated temporarily for a variety of reasons, with the intention of restarting production at a later time. The length of inactivity may be defined by state regulations, before they are declared “abandoned” and closure required.

1. Divert all surface water runoff away from the earthen structure. This includes runoff from building roofs, abandoned feedlots, and cropland.
2. Remove all liquid, pumpable sludge and solids. Refer to dewatering procedures discussed earlier for details.
3. Refill the storage with water. Keep liquid levels at least 24 inches below the top of the storage, or at the maximum level allowed by state regulations. The added water will help to limit damage to the sidewalls from weed growth, erosion, and burrowing animals.
4. Manage the structure to prevent liquid overflow. Land-apply excess liquid from the structure in a manner that protects water quality. It must not be discharged into surface waters.

Incremental Closure Procedures

Incremental closure is a modification of Option A listed above. It has been used to close abandoned lagoons in the Southeastern US. Incremental closure is well suited for the permanent elimination of lagoons in the following situations:

- Large surface areas (greater than 2 acres) where agitation is difficult,
- Earthen manure structures with narrow embankments that are unable to support tractors and agitators to suspend settled solids and sludge,
- Earthen manure structures with degraded embankments or slopes,
- Earthen manure structures with bottoms below groundwater table,
- Large length to width ratios that are difficult to properly mix or access with agitator,
- Soil or fill material unavailable locally to completely fill existing structure, and
- Earthen manure structures that will ultimately have their sidewalls removed and the facility filled in with soil or reshaped to match the existing contour.

An earthen manure structure that is incrementally closed would generally undergo the following steps (Figure 2):

1. Agitation equipment is located at one end or corner of the structure. Sludge is agitated, removed from the structure and land applied.
2. Once the depth of settled/accumulated material is reduced to less than about 0.3 m (1 ft) by agitation and pumping or with a sludge dredge, bulldozers or other earth moving equipment slowly move the sidewalls by adding fill at a rate of approximately 3 to 4.5 m (10-15 ft) at a time toward the center of the structure.
3. As the embankment is pushed inward, the agitated sludge will be displaced by the fill and pushed toward the center of the structure, rather than being covered with soil.
4. Soil cores should be taken to monitor the process and ensure that the fill encloses a minimal amount of sludge. Borings, with a soil auger, should be made and the depth of sludge remaining in the structure after the previous movement of the lagoon embankment estimated. No chemical analysis is required. Rather, the soil cores serve as a quality control practice to ensure that the sludge is being moved toward the “open” portion of the lagoon, rather than being buried. Cores should be taken along the “filled-in area” to depths corresponding to the previous bottom elevation of the structure. Each core should represent approximately 70 sq m (750 sq. ft.) of area. A record should be kept of where the cores were taken as well as a measure of amount of sludge remaining.
5. Agitation equipment is moved across fill surface as the earthen structure is filled in. Agitation, solids removal, embankment movement and soil core samples continue until the structure is reduced to a size manageable by agitation equipment alone or until all contents are removed.

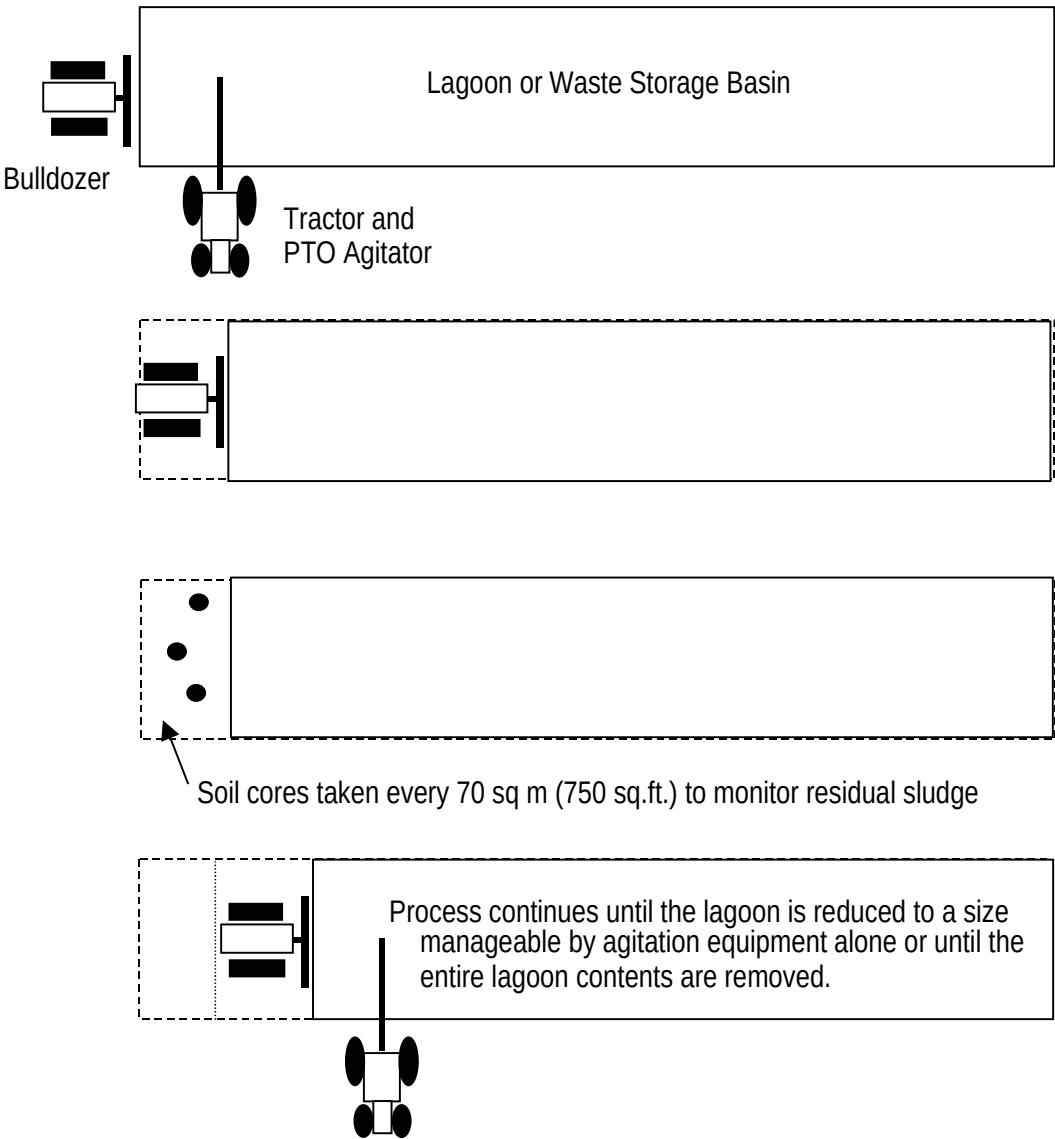


Figure 2. Incremental closure procedures for closing lagoons and storage basins.

The goal of incremental closure is to remove the vast majority of sludge material while avoiding handling thick layers of sludge greater than 0.13 m (>5 inches) and potentially damaging the liner. To minimize the sludge layer thickness while closing the unit:

- Agitate sludge and solid material periodically, as the structure is closed,
- Move embankment a shorter distance, or
- Place the bulldozer blade lower in the existing soil to push sludge material over from beneath.

Timing of Closure

The proper timing of earthen lagoon or manure storage structure closure continues to be debated. Should it be closed immediately upon cessation of operation or would it be better to wait 3 to 5 years? While environmental concerns remain after operation ceases, the level of risk tends to decrease over time if the structure is properly maintained. A number of advantages and disadvantages, both economically and environmentally, exist for either scenario. Allowing more time for closure gives more flexibility in applying the sludge. Applying at agronomic rates may be very difficult given the high concentration of nutrients in the sludge layer, and applying the sludge over a period of years instead of all at once may be more environmentally friendly. The structure must be maintained during this time of disuse just as it was during operation, including regular inspections, controlling burrowing animals, maintaining proper vegetation on berms, and pumping when necessary to maintain safe water levels. Continued maintenance, along with the potential increased cost for setting up equipment to pump sludge multiple times rather than all at once, may represent a significant cost to the operation.

Advantages of immediate closure include:

- Expense of maintaining berms and pumping lagoon ends quickly.
- Possibility of overtopping or leakage ends quickly.
- Closing it in one operation should minimize expense of pumping and hauling sludge.

Advantages of slower closure include:

- Pathogens existing in sludge are more likely to die or be reduced to insignificant levels.
- Nutrients in sludge can more easily be applied at agronomic rates over a longer period of time.

BACKGROUND AND LITERATURE REVIEW

Solids Profile in Typical Earthen Lagoon

In a manure storage or basin, the contents are likely to be relatively uniform throughout, with solids content ranging from 2 to 10%. In an anaerobic lagoon, however, three different zones are likely to be found (Figure 3). These zones seldom have distinct boundaries and are difficult to determine.

1. Relatively inert solids accumulate near the manure inflow points (Figure 3). This material may be high in phosphorus, with a discernible interface between the solids and the sludge. Complete removal of these solids is difficult without damaging the liner. Therefore, maintaining liner integrity should be of even greater concern than removal of all solids. There is typically more solids buildup in lagoons receiving manure from poultry and dairy operations than from swine.

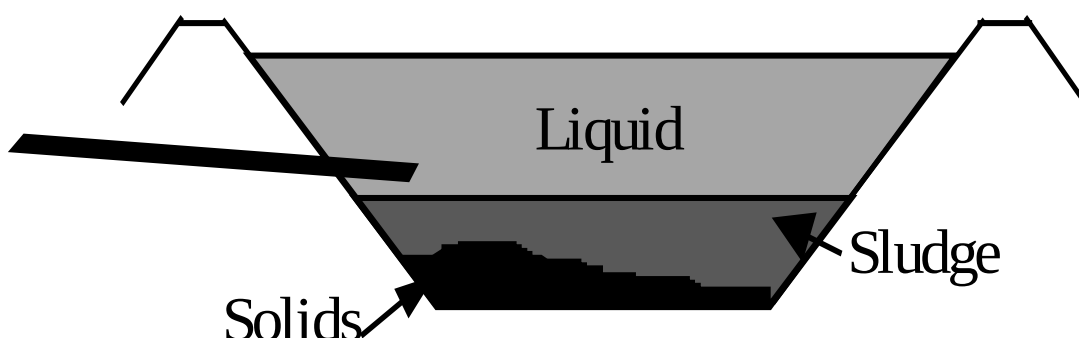


Figure 3. Cross-section of an anaerobic lagoon.

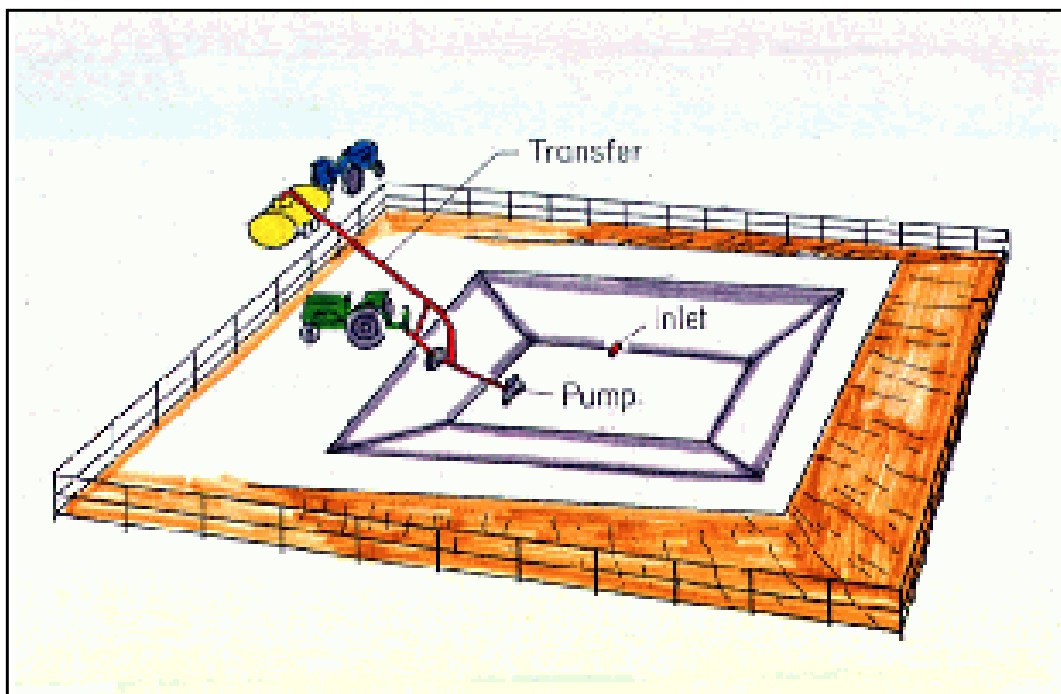


Figure 4. Removal of sludge from an earthen storage of lagoon for application to cropland.

2. A thick sludge, high in nutrients, bacteria, and organic matter, is normally located just above the solids zone. Pumps designed to handle high solids content can remove this material (Figure 4). While much of the readily degradable organic matter in the sludge should be broken down, it is still biologically very active and a likely source of much of the anaerobic degradation of incoming manure occurring in a lagoon.
3. Above the sludge is a liquid layer that is low in solids and moderately rich in nutrients. It is easily pumpable with conventional chopper-agitators or irrigation pumps. The liquid and most of the sludge can be removed by pumping while maintaining the integrity of the liner. The liquid can be irrigated onto cropland, but it may be necessary in some cases to move sludge using tanker wagons (Figure 4).

The settled solids and sludge layers of an anaerobic lagoon can contain a significant amount of phosphorus that has settled out over the years (Table 3). According to Barker (1996), organic nitrogen compounds tend to accumulate in the sludge at levels that are up to 13 times higher than in the liquid while phosphorus accumulate at rates that are up to 55 times higher. In addition, the sludge may also contain significant concentrations of heavy metals, salts and other trace elements. These factors dictate the need for laboratory analysis and for expert agronomic advice prior to land application. Sheffield (2000) found sludge volumes and total nutrients to be highly variable in a study of thirty single-cell swine lagoons in North Carolina. He concluded that volume and concentration could not be estimated accurately based on values from other lagoons. Likewise, the land area needed to apply the sludge at agronomic rates was highly variable. Mukhtar (2000) found relatively high levels of all nutrients in a mixture of sludge and supernatant for dairy manure lagoons in Texas (Table 4).

Published sludge accumulation rates are highly variable, but estimates can be made using Table 5 if field measurements are not available. Periodic sludge removal over the life of the anaerobic lagoon enables the phosphorus accumulation (Table 6) to be managed more easily at the time of closure. Purdue Extension recommendations (ID-120, "Design and Operation of Livestock Waste Lagoons") call for sludge agitation and removal from first-stage or single-stage lagoons every three to five years.

Table 3. Livestock anaerobic lagoon sludge characteristics (units g/L (lbs/1,000 gal)).

Species	Units	Total Nitrogen		Total Phosphorus (P ₂ O ₅)		Potassium (K ₂ O)		Copper		Zinc	
		Total Nitrogen	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Swine – active ^a	mg/l (lbs/1,000 gal)	2,930 (24.4)	1,620 (13.5)	6,310 (52.6)	4,120 (34.3)	780 (6.5)	470 (3.9)	36 (0.3)	36 (0.3)	96 (0.8)	72 (0.6)
Swine – inactive ^b	mg/l (lbs/1,000 gal)	2,690 (22.4)	1,320 (11)	1,550 (12.9)	940 (7.8)	170 (1.4)	170 (1.4)	144 (1.2)	160 (1.3)	140 (1.2)	72 (0.6)
Dairy ^a	mg/l (lbs/1,000 gal)	2,290 (19.1)	1,040 (8.7)	5,020 (41.8)	3,940 (32.8)	1,100 (9.2)	860 (7.2)	60 (0.5)	48 (0.4)	84 (0.7)	48 (0.4)
Dairy ^c – complete mix, sludge and supernatant	mg/l (lbs/1,000 gal)	1,990 (16.6)	830 (6.9)	1,070 (8.9)	540 (4.5)	1,750 (14.6)	600 (5)	13 (0.11)	15 (0.12)	19 (0.16)	11 (0.1)
Poultry – layer ^a	mg/l (lbs/1,000 gal)	2,500 (20.8)	1,420 (11.8)	9,260 (77.2)	4,790 (39.9)	1,180 (9.8)	920 (7.7)	12 (0.1)	12 (0.1)	130 (1.1)	120 (1)
^a Barker, J.C., J.P. Zublena, and C.R. Campbell. 1994. Livestock manure production and characterization in North Carolina. Agri-Waste Management Bulletin. Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh, NC.											
^b Sheffield, R. E. 2000. Sludge and Nutrient Assessment of Inactive Lagoons in North Carolina. Presented at the 2000 ASAE Annual International Meeting. ASAE Paper No. 004121. ASAE, 2950 Niles Rd., St. Joseph, MI 49085-9659 USA.											
^c Mukhtar, S. 2000. Assessment of Nutrients and Sludge from Dairy lagoons in Texas. (Unpublished data.)											

Table 4. Texas dairy lagoon sludge and supernatant mixture data (Mukhtar, 2000).

County	% Total Solids	% Volatile Solids	pH	TKN	P ₂ O ₅	K ₂ O	No. of Samples*	No. of Lagoons
				mg/l (lb/1000gal), as is				
Erath	7.1	2.4	7.4	1765(14.7)	935(7.8)	1540(12.8)	10	8
Hamilton	7.1	3.9	7.6	2485(20.7)	1465(12.2)	2245(18.7)	10	2
Comanche	2.5	1.5	7.7	1730(14.4)	1105(9.2)	1475(12.3)	15	3
* Each sample represented supernatant and suspended sludge mixture from the primary lagoon.								

Nutrient Issues

Planning for the proper utilization of nutrients should be done when the animal manure management system is designed. Nitrogen is the contaminant that is most likely to affect ground water. Movement of nitrogen from an abandoned storage facility can be estimated by measuring organic, nitrate and ammonium nitrogen in the ground water, both up and down slope of the structure. Nitrates are rarely found in stored manure due to anaerobic conditions. (Lightly loaded feedlot runoff storage ponds may be the exception.) However, other forms of nitrogen can be converted to nitrates if they encounter aerobic conditions. Westerman et al. (1995) found significant levels of ammonia and nitrate in wells near unlined lagoons constructed in sandy soils. Heavier soils with a high cation exchange capacity or a properly constructed and maintained liner should restrict the movement of ammonium and organic nitrogen.

When closing an earthen manure structure, the producer must handle a large quantity of liquids and manure solids. The land application area required will be significantly more than in normal operation. Often a producer must devise other methods of utilizing the manure, such as applying on land owned by neighbors, or developing a multi-year closure plan. If an anaerobic lagoon or runoff holding pond is left unused for a period of time, the nutrient level in the liquid layer becomes less concentrated, but the nutrients in the sludge layer are relatively stable and tend to remain as long as the sludge layer is covered with water (Sheffield, 2000).

Table 5. Rates of sludge/solids accumulation in lagoons. (Modified from USDA-NRCS, 1992.)

Sludge Accumulation in l/hd/yr (ft ³ /hd/yr)		Sludge Accumulation in l/hd/yr (ft ³ /hd/yr)	
<u>Swine</u>		<u>Poultry</u>	
Nursery	85 (3)	Layer	14 (0.5)
Grow/Finish**	452 (16)	Broiler	17 (0.6)
Sows and litter	1500 (53)	Turkey	23 (0.8)
Sows (gestation) and boars	395 (14)	<u>Dairy</u>	
<u>Beef</u>		Lactating cows	10,755 (380)
Feeder (high energy diet)	4,955 (175)	Dry cow	7,500 (265)
Feeder (high forage diet)	5,660 (200)	Heifers	4,530 (160)
** Bicudo et al. (1999) found a value of 203 l/hd/yr (7.2 cu ft/hd/yr).			

Table 6. Calculation of phosphorus accumulation in the sludge and settled solids in a first-stage or single-stage anaerobic lagoon.*

	Number of Animals (average capacity) (A)	Average Animal Weight, kg (lb) (B)	Sludge P ₂ O ₅ Accumula- tion (unit P ₂ O ₅ /unit of animal weight per year, kg/kg or lb/lb)* (C)	Years Accumulation of Sludge and Solids (E)	Total P ₂ O ₅ in Sludge and Solids, kg (lb) (A×B×C×E)
<i>Example: Finish</i>	1000 ×	68 (150) ×	0.09** ×	10 =	61,200 (135,000)
Swine					
Nursery	×	×	0.2 ×	=	
Grow/finish	×	×	0.09** ×	=	
Sows and litter	×	×	0.08 ×	=	
Sows (gesta- tion) and boars	×	×	0.03 ×	=	
Dairy					
Lactating cow	×	×	0.07 ×	=	
Dry cow	×	×	0.05 ×	=	
Heifer	×	×	0.02 ×	=	
Beef					
Feeder (high energy diet)	×	×	0.05 ×	=	
Feeder (high forage diet)	×	×	0.06 ×	=	
Poultry					
Layer	×	×	0.07 ×	=	
Broiler	×	×	0.08 ×	=	
Turkey	×	×	0.07 ×	=	
* Assumes 65% of the phosphorus excreted by the animals settles into the sludge or settled solids. This table does not apply to manure storages or runoff holding ponds for outdoor lots that are normally cleaned each time manure is removed. Sludge accumulation rates are highly variable, depending on climate, animal species, ration and management, and sampling is needed for reliable nutrient estimates.					
** Bicudo (99) found 0.03					

Table 7. Pathogen inactivation with time for lagoon stored anaerobically stabilized biosolids (Reimers et al., 1990).

Pathogen	Time (months)	Log Reduction
Ascaris eggs	15	>3 log
Total coliforms	9	2 log
Fecal coliforms	6	> 4 log
Fecal streptococcal organisms	3	1 to 3 log
<i>Salmonella livingston</i>	2	> 7 log
Poliovirus	6	> 5 log

Pathogen Issues

Most soils are effective filtering media for pathogens. (This has been the rationale for septic system design in the US for many years.) Phosphorus chemically binds to soil to form a variety of non-soluble complexes. Phosphorus and pathogens should not be a significant problem in soils around an abandoned storage unless the water table is within 0.61 m (24 in) of the bottom of the facility, based on the requirement of 0.61 m (24 in) of unsaturated (aerobic) flow used to design septic system absorption trenches in most states.

Earthen manure structures not only provide storage but also treatment (Reimers et al., 1999). Significant removal of live pathogens usually occurs in stored manure over time, particularly in lagoons. The concentration of pathogens varies depending on the source. In biosolids, infectious agents are generally divided into four classifications: bacteria, viruses, protozoa, and helminths. The most resistant pathogens are the helminth eggs of *Ascaris* and *Toxocara*. In most manures, resistant helminth *Ascaris* eggs have not been detected, and usually only found in swine manure where the hogs are not confined (Bicudo and Olezkiewicz, 1996). *Toxocara* eggs are found only in cat and dog feces. The predominant resistant pathogens in manures are probably viruses and protozoa oocysts, microorganisms that should be less resistant than *Ascaris* and *Toxocara*.

Biological treatment, aerobic and anaerobic digestion, has been shown to be an effective method of pathogen inactivation. Reimers et al. (1990) monitored anaerobic lagoon stabilized biosolids that were spiked by *Ascaris* eggs, *Salmonella livingston* and poliovirus over a two-year period. The data from their study (Table 7) showed the time in months for total die off or for log reductions. The temperature in these lagoon studies was observed to be in the range of 26° to 25°C (79° to 77°F) from April to October and 20° to 17°C (68° to 63°F) from November to March. They concluded that pathogens tend to die off at a much greater rate in lagoons than in soils. Therefore, as a general rule, it can be concluded that lagoon treatment facilities and waste storage ponds that have been idle for several years will likely be stable and not pose a threat to human safety due to pathogens (Reimers et al., 1999). However, if there is any question or doubt, bioassays of the material can be taken within the structure (both water and manure biosolids) to verify the levels of pathogens and the course of disinfection if concentrations exceed the human infective dose (Henry and Reimers, 2000).

Seepage and Contamination Potential

Seepage, expressed as flow volume per unit area and time (cm/day or inch/day), is defined as the loss of liquid by infiltration or percolation from canals, reservoirs or manure storage, and treatment structures (ASAE, 2000). For decades, anaerobic lagoons have been built to store and biologically treat manure and wastewater from livestock and poultry operations. Properly designed and operated lagoons are efficient in liquefying and volatilizing organic solids and are a convenient method of manure and wastewater handling, storage, and disposal. Despite these attributes, the residual material in lagoons contains nitrogen, salts, bacteria, viruses, pharmaceuticals, and other potential contaminants (Bitton, 1999). While lagoons built after about 1990 may have well-compacted clay or synthetic liners, many older lagoons relied upon native soil properties and self-sealing processes to reduce seepage. Sidewalls of these earthen structures may have a higher seepage rate than the bottom due to fluctuating liquid levels causing shrink/swell cracks or due to macropores created by worm, rodent, and root activity. Sidewall seepage rates can also be higher if the structure was excavated using the “stair step” or incremental method vs. the “bath tub” or “all at once” approach (NRCS Field Handbook).

Gas release from microbial activity in soil beneath the seal can cause rupture of the lagoon seal (Ciravolo et al., 1979). This is why proper construction of unlined earthen manure structures requires the removal of all organic materials down to mineral earth. Another likely area for seepage is at the junction of the sidewalls and the floor of the structure.

Research indicates that manure has sealing characteristics that becomes more effective over the operational life of the earthen structure. Ham and DeSutter (1999) cited investigations of three modes of sealing: physical clogging of soil pores by manure particles, biological sealing by microbial products, and chemical sealing from salt-induced dispersion of particles in clay liners. Most studies have concluded that physical clogging of soil pores was the primary sealing mechanism. Barrington et al. (1987) suggested that biological mechanisms could also intervene to strengthen physical seals where ambient temperatures exceed 15°C (59°F). They observed that swine manure, because of its granular and easily biodegradable character, required a finer soil to effectively seal than did more fibrous, fermentation-resistant dairy manure solids. Soil sealing by dairy manure was found to be almost instantaneous.

Davis et al. (1973) measured infiltration rate of the floor of a newly constructed dairy manure storage basin using 20 cm (8 in)-diameter cylinders. Seepage of fresh water was measured at 120 cm/day (47.2 in/day). For the same structure, seepage for dairy manure and wastewater was 5.8cm/day (2.3 in/day) after two weeks and decreased to 0.5 cm/day (0.2 in/day) after four months. The concluded from this 240:1 seepage reduction that dairy waste ponds sealed effectively over time.

Robinson (1973) measured seepage from a storage pond at a beef cattle operation. The existing pond was cleaned out with a backhoe prior to the experiment. Seepage rates were measured by monitoring wastewater level fluctuations and subtracting estimated evaporation rates from the wastewater levels (water balance approach). Initially, the seepage rate was 11 cm/day (4.3 in/day) but reduced to 0.3 cm/day (0.12 in/day) after six months, for a 36:1 drop. Other full-scale field studies have measured seepage losses of varying magnitudes from earthen lagoons and ponds for dairy (Demmy, 1993; Ham et al., 2000), and swine (Glanville et al., 1999; Ham et al., 2000) lagoons and earthen storage structures built on coarse or fine soils and with or without liners. Ham et al. (2000) concluded that although measured seepage rates were small (0.02 cm/day or 0.008 in/day), as much as 111,900 kg N/Hectare (100,000 lb N/ac) could seep into the subsoil under lagoons over a period of 20 to 30 years. Glanville et al. (1999) calculated seepage from 28 earthen manure storages using a mass balance approach. Only 4% showed leakage significantly greater than the 0.159 cm/day ($1/16$ in/day) standard in use when the storages were built. They could find no significant difference in seepage between lagoons and earthen manure slurry storages and determined that structures in glacial till showed significantly lower leakage rates than those constructed in sand and gravel, colluviums or loess. Brune et al. (1994) concluded that the “water balance” approach did not adequately estimate seepage from earthen structures. Feng et al. (1992) found that a mathematical model, calibrated and validated using data from a field study site in NC, agreed well with field monitoring. Long-term simulations indicated that ammonium was the dominant form of nitrogen in the soil around the study site. The contaminant front was predicted to advance by 60 m (197 ft) per year in sandy soil.

Ham et al (1999) collected soil core samples from an abandoned cattle feedlot lagoon in KS where the sludge had been allowed to dry and had been removed. The cores showed ammonium nitrogen levels of 400 ppm near the original lagoon bottom, decreasing to 30 ppm at 5 m (16.4 ft) below the bottom, with 90% of the nitrogen within 3 m (9.8 ft) of the lagoon liner. In one area where the soil was very sandy, ammonium levels at 5 m (16.4 ft) were 66 ppm. Chloride levels did not decrease with depth because the negatively charged chloride ions were not attracted to the negatively charged clay particles in the soil. Their report suggested that aquifer depth and vulnerability should influence the closure procedure chosen. Nordstedt et al. (1971) installed monitoring wells at a three-stage dairy lagoon system to a depth of 2.43 m (8 ft) below the ground surface at distances of 4.6 (15 ft), 15.2 m (50 ft), and 30.48 m (100 ft) from the lagoons and found evidence of lagoon seepage by sampling biochemical oxygen demand (BOD), salts, and nitrate-nitrogen (NO₃-N). Sewell (1978) used monitoring wells near a new dairy lagoon and found elevated levels of NO₃-N in water samples immediately after loading the lagoon with manure and wastewater. After a six-month period, however, these levels had declined to near those measured before loading. Sealing of

the lagoon was cited for this decrease. Hoffman and Westerman (1995) studied 11 well-established, unlined swine manure lagoons in the lower coastal plain of North Carolina for evidence of seepage. At five of the lagoons, estimated losses were low and likely not a threat to groundwater. Four lagoons showed moderate losses and two were severe. They concluded that a large number of similarly constructed lagoons in North Carolina might also have unacceptable levels of seepage. A five-year monitoring of ground water near two newly constructed swine lagoons, located in areas with shallow groundwater, indicated elevated concentrations of several chemicals including ammonium and chloride (Westerman et al., 1995).

Soil samples collected from in and around lagoons and earthen storage structures suggest that the magnitude of contaminant losses from lagoons varied from site to site due to the differences in waste chemistry, type of animal feeding operation, soil type, and liner construction. Baker et al. (2000), reported results from a study that analyzed soil from around earthen swine manure storage structures in Iowa. Soil was sampled to a depth of 2.4 m (8 ft) around the perimeter of 31 earthen manure structures, along with an upslope background sampling point to estimate leaching. A contaminant concentration ratio of three times the background levels was considered to be "elevated." They found elevated nutrient levels on only one or two samples around the perimeters of each lagoon, indicating that seepage was localized rather than widespread. Nine of the seventeen basins had elevated ammonium levels compared to background levels but did not have concurrent levels of chloride, indicating that the contamination was not recent.

Parker et al. (1999) collected soil samples from borings made to a depth of 6.1 m (18.8 ft) from underneath a 22-year-old beef feedlot runoff storage pond. Elevated levels of chloride, ammonium, and organic nitrogen were found. Also, isolated areas of nitrate were found beneath sidewalls of the pond containing lot runoff. Core samples taken during closure at seven different locations in the berm and bottom of a two-stage swine manure lagoon that had received runoff from shed and lot finishing facilities indicated wide variations in seepage (Hawkins and Boyer, 2000). As indicated by organic matter content and Bray P tests, seepage was not apparent below 61 cm (24 in) in either storage. Ritter et al. (1984) monitored a two-stage anaerobic swine lagoon for four years without finding a significant impact on groundwater. In an animal manure lagoon water quality study, Ham et al. (2000) sampled soil cores between 3 m (10 ft) and 4.6 m (15 ft) beneath several cattle and swine lagoons that had been in use between 11 and 30 years. The highest ammonium levels were found immediately under the soil liner. Ammonium decreased rapidly with depth and was essentially contained in a 1.5-3 m (5-10 ft) soil zone under the lagoons. They cautioned that when a lagoon is closed and allowed to dry, ammonium could convert to $\text{NO}_3\text{-N}$ and move more rapidly towards the groundwater. They also noted the importance of knowing as much as possible about the history of a soon-to-be-closed earthen manure structure. Any facility that was improperly sited, designed, and constructed would have a greater risk of groundwater contamination due to excessive seepage losses. The feedlot catchments studied by Clark (1975) lost water by seepage. Chemical analyses of cores from naturally occurring playa lakes in the Southern High Plains used to collect runoff from cattle feedlots indicated that the seepage had moved past the 3.5 m (11.5 ft) depth. However, this was indicated only by an increase in the chloride content from 25 to 125 ppm at 3 m when the surface was inundated with water containing over 1000 ppm chloride for 5 years. Little nitrate or nitrite moved below 1 m. Clark concluded that while small amounts of seepage reached groundwater, it was low in nitrate.

Culley and Phillips (1989) monitored small-scale unlined earthen dairy manure storages, 100 cu m (3,530 cu ft) and 1.5 m (5 ft) deep, in sand, sandy loam and clay loam soils for five years. They looked at N, P and mineral content of water in the undisturbed clay underlying the storages. Nutrient content increased at 1.75 m (5.7 ft), 2.5 m (8.2 ft) and 3.5 m (11.5 ft) below the berms and pits in all cases over time indicating that the small-scale storages did not seal effectively during the study. The waterborne inorganic N, P and mineral levels found in clay soils of similar hydraulic conductivity were strongly affected by the properties of the overlying soil. The greatest increases were in storages constructed in acidic sands. There were considerable increases in both total P and PO_4 , but no changes in inorganic N contents beneath clay loam storages. Westerman et al. (1995) investigated two new swine manure lagoons located in sandy, unlined coastal plain soil for 3.5 to 5 years after receiving waste. Monitoring wells indicated broad seepage plumes; with ammonia levels from as low as 1 mg/l to as high as 143 mg/l. The authors concluded from the highly variable re-

sults that it is extremely difficult to predict seepage rates from lagoons. Results of studies by Ciravolo et al. (1979) clearly indicated the importance of properly siting earthen structures by the increased seepage found at three sites with sandy surface layer soils and either sand or heavier sub-surface layers. Page and Loudon (1983) summarized and compared ten lagoon seepage studies and found a great deal of variation. They concluded that future research was needed to determine the effect of pumping on the lagoon seal.

Liquid and Sludge Removal

The Minnesota Pollution Control Agency recommends agitation, suspension and removal of the sludge in the bottom of abandoned earthen storages, scraping out the solids layer left in the bottom and land-applying the removed material at agronomic rates. The remaining structure should be filled in using earthen berm material and other material permitted for this purpose by state and federal regulations. Abandoned concrete pits should also be cleaned and filled in.

Natural Resources Conservation Service Conservation Practice Standard Code 360 states that assuming the structure was properly constructed and that the liner is intact, the following applies: “All structures used to convey waste to waste impoundments shall be removed and replaced with compacted earth material or otherwise rendered unable to convey waste. Liquid and slurry wastes shall be agitated and pumped to the extent conventional pumping will allow. Clean water shall be added as necessary to facilitate the agitation and pumping.” The Indiana closure standard states that “the sludge remaining on the bottom and sides of the waste treatment lagoons or waste storage ponds shall be removed to the fullest extent practical without damaging the liner”

When cut-and-fill structures are closed, the contents should be removed before the embankment is breached. Final side slopes should be no steeper than 3 to 1. In excavated impoundments, backfill height should exceed the design finished grade by 5% to allow for settlement. The finished surface should be constructed of the most clayey material available at the site, covered by topsoil and mounded to shed rainfall.

Putnam (1998) stated that “Although risks associated with lagoons are assumed to remain until wastes within the impoundment are either removed or stabilized, risks also exist with closing lagoons. Under the current Natural Resources Conservation Service (NRCS) Lagoon Closure Standard used in the state [North Carolina], all wastes in a lagoon must be removed and land applied. A cleaned lagoon can be filled with an inert material such as sand or if the structural integrity of the impoundment allows, it may be used as a freshwater pond. Land application of removed waste can create nonpoint source pollution through nutrients carried by runoff and, if not removed by crops, may also pose risks to ground water. Irrigated wastes also produce odors that may be offensive to nearby residents. Additionally, the accumulated solid waste (sludge) in the bottom of a lagoon contains high concentrations of heavy metals. When sludge is land applied, these metals may accumulate in soils and limit the ability of the soil to produce certain crops.”

ADDITIONAL RESEARCH NEEDS

This paper summarizes what is known about the closure of earthen manure structures and attempts to outline safe procedures to do so. Still, there are several issues that are not well understood and would benefit from additional research.

- Proper closure procedures for poorly maintained earthen structures?
- Proper closure procedures for earthen structures in environmentally high-risk areas, e.g. sandy soils, shallow water tables, karst areas, etc.?
- Economic and engineering study of sludge removal and utilization.
- Study of viability, fate, and transport of pathogens, hormones, and pharmaceuticals in seepage and sludge of lagoons and earthen waste storage structures.
- The types of pathogenic organisms found in animal manure structures, and their longevity when spread on soil, injected into soils, or left in the lagoon or storage basin is poorly understood. Most pathogen research has been done with human biosolids, which are similar, but not identical to animals.
- Soil sampling/monitoring techniques to decide how much of the sludge and liner to remove during closure.

- Do economically viable methods for remediation of soil contamination sites around a structure exist?
- Research is needed to identify economically viable methods to determine whether unacceptable levels of seepage have occurred around an earthen basin. For instance, how closely spaced and how deep should soil borings be taken?
- Fate of nitrogen in the soil beneath an earthen manure structure after closure.
- Sludge characteristics and accumulation rates in different types of manure structures.

SUMMARY AND CONCLUSIONS

A thorough review of the literature dealing with closure of animal manure lagoons and earthen manure storages shows quite varied results and indicates the need for a site-specific evaluation in order to accurately evaluate the potential environmental damage from closure. Still, there are several conclusions that can be reached:

The overall potential for environmental contamination should be taken into account when closing a structure. Application on land with crops that can utilize the nutrients without damage to ground or surface water must be available. It may be important to properly schedule the removal and land application of sludge over a period of several crop years to ensure this happens. If land is not available to apply the sludge, other means of utilization must be available.

A site-specific evaluation is important to ensure that the structure was properly sited, designed, constructed and operated. If it was not and if an investigation shows contamination of the site is ongoing, closure procedures should be completed as soon as possible.

There are a number of questions that remain after our literature search. Specifically:

- What is the most versatile and suitable equipment to efficiently dewater/desludge lagoons in an environmentally safe fashion?
- Are there chemical/biological additives that can reduce/liquefy sludge effectively?
- How much reduction in the sludge accumulation rate can be expected due to a solid-liquid separation system in the manure stream ahead of an earthen structure?
- Can models be developed to more accurately estimate sludge buildup?
- What is the mineralization rate of nitrogen and other nutrients to be land applied from sludge and what is the salt content of sludge?
- What is the feasibility of composting very high moisture sludge removed from a lagoon?

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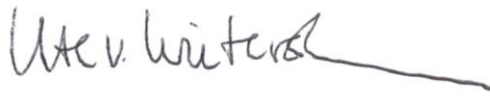
Translation Declaration

I, Ute von Wietersheim, do hereby declare as follows:

1. I certify that the attached translation from German to English is an accurate representation of the documents received by this office. The document is designated as: 2024 03 11--Funck Declaration (German).

2. Ute von Wietersheim, Translator of Questel-Orbit, Incorporated, attests to the following: "To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

3. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under the laws of the United States, including 18 U.S.C. § 1001.

Signature: 

Name: Ute von Wietersheim

Title: Translator, Questel-Orbit, Incorporated

Date: March 12, 2024

I, Eckhard Funck, hereby declare the following based on my personal knowledge:

I. INTRODUCTION

1. I am over the age of 18. My current residence is in Nentershausen, Germany.
2. I am a former employee of the company UD Umwelt-Dienste GmbH (“UD Umwelt-Dienste”). I worked for UD Umwelt-Dienste from 2002 to 2017.
3. While employed at UD Umwelt-Dienste, I personally used the SenwaTec Amphi-King vehicle (“Amphi-King”) to pump sewage slurry from sewage lagoons. In addition, I was personally involved in marketing and promotional activities related to these services. These marketing and promotional activities included advising the marketing team of UD Umwelt-Dienste and working with the marketing and sales teams of UD Umwelt-Dienste to engage with customers and to answer their questions.
4. I have no financial interest in the outcome of this proceeding. I will be paid a reasonable rate of EUR 300/hour for my time looking for information about my work for UD Umwelt-Dienste.

II. BACKGROUND

5. In my experience, prior to August 2013, the purpose of UD Umwelt-Dienste’s marketing materials was to educate the public and generate public interest in their services. Prior to August 2013, it was UD Umwelt-Dienste’s standard business practice to make its marketing materials publicly available, e.g., by distributing them to customers and potential customers and also making them accessible on their website. Prior to August 2013, if customers or potential customers sought information such as brochures, marketing videos, treatment plant demonstrations and marketing materials about the UD Umwelt-Dienste’s services relating to the Amphi-King, this information would be provided freely and without any confidentiality

restrictions. For example, prior to August 2013, customers of UD Umwelt-Dienste occasionally described the problems they had with their facilities. UD Umwelt-Dienste would discuss these problems with the customers and provide them with USB sticks with the video in Exhibit C.

6. The sewage slurry pumping services offered by UD Umwelt-Dienste using the Amphi-King had been written about in news publications prior to August 2013. Several of these publications show me personally operating the Amphi-King and pumping sewage slurry in sewage lagoons. See e.g., Exhibit A (available at <https://www.hna.de/lokales/rotenburg-bebra/frosch-vorbild-1376974.html>); Exhibit B (available at <https://www.mainpost.de/regional/main-spessart/gequirlter-klaerschlamme-art-5778615>). UD Umwelt-Dienste appreciated the publication of its services as it helped draw public attention to the lagoon pumping services offered by UD Umwelt-Dienste.

7. In addition, UD Umwelt-Dienste created its own marketing materials in which the lagoon treatment services (pumping and removal) was presented. See e.g., Exhibit C. Exhibit C contains screenshots from a marketing video for the lagoon agitation and pumping services offered by UD Umwelt-Dienste using the Amphi-King. It was created and publicly distributed prior to August 2013. I am personally familiar with this marketing video. See Exhibit C for screenshots from various sections of this marketing video.

III. AUTHENTICITY AND PUBLIC ACCESSIBILITY OF EXHIBIT A

8. Exhibit A is a true and accurate copy of a newspaper article entitled *The Frog as a Model* dated August 25, 2011, which truthfully and accurately depicts and describes me operating the Amphi-King in a sewage slurry lagoon while pumping the sewage slurry. During my operation of the Amphi-King shown in this newspaper article from August 25, 2011, I maneuvered the Amphi-King from the dry land, over the bank of the lagoon, and into the sewage

slurry lagoon. Using the Amphi-King's pump and nozzle and screw and wheels, I agitated and mixed the sewage slurry. When the sewage was sufficiently agitated, I connected a hose to the Amphi-King pump and used the Amphi-King to pump the sewage out of the lagoon.

IV. AUTHENTICITY AND PUBLIC ACCESSIBILITY OF EXHIBIT B

9. Exhibit B is a true and correct copy of a newspaper article entitled *Agitated Sewage Slurry*, dated October 15, 2010, which truthfully and accurately depicts and describes me operating the Amphi-King in a sewage slurry lagoon and pumping sewage slurry. During my operation of the Amphi-King shown in this newspaper article dated October 15, 2010, I maneuvered the Amphi-King from the dry land, over the bank of the lagoon, and into the sewage lagoon. Using the Amphi-King's pump and nozzle and screw and wheels, I agitated and mixed the sewage slurry. When the sewage was sufficiently agitated, I connected a hose to the Amphi-King pump and used the Amphi-King to pump the sewage out of the lagoon.

V. AUTHENTICITY AND PUBLIC ACCESSIBILITY OF EXHIBIT C

10. Exhibit C is a true and accurate copy of a series of screenshots from a marketing video released by UD Umwelt-Dienste to the relevant public and customers prior to August 2013. The screenshots shown in Exhibit C truthfully and accurately portrays the marketing video of UD Umwelt-Dienste. It shows me operating the Amphi-King in a sewage slurry lagoon and pumping sewage slurry in April 2012.

11. UD Umwelt-Dienste created the marketing video shown in Exhibit C before May 7, 2012. I know that the video shown in Exhibit C was created before May 7, 2012, because this marketing video was shown at the IFAT Trade Show in Munich between May 7 and 11, 2012. IFAT is a large trade show for water, sewage, waste and the feedstock industry. I would estimate that around 100,000 people visited the IFAT Trade Show in 2012.

12. I personally saw this video playing on the TV screens at the booth that UD Umwelt-Dienste had at the IFAT Trade Show in May 2012. Hundreds of visitors walked past the booth and saw the video that was playing. A copy of this same video was later uploaded to YouTube and can be found under the following link:
<https://www.youtube.com/watch?v=ecnlfMf7CH4&t=1s>. The video shown under this link is the same video that was publicly shown at the IFAT Trade Show in May 2012.

13. After the IFAT Trade Show and before August 2013, USB sticks with a copy of the video were sent to many interested customers of UD Umwelt-Dienste, including, without limitation or restriction, EWE Wasser GmbH. There were no confidentiality restrictions for those who saw the video at the IFAT Trade Show or who were later sent a copy of the video.

VI. AUTHENTICITY OF EXHIBIT D

14. Exhibit D is a true and correct copy of a table with data about a sewage slurry lagoon from which I pumped sewage slurry with the Amphi-King on behalf of UD Umwelt-Dienste before August 2013.

15. This data was collected to comply with the legal requirements for the use of material from sewage slurry lagoons as fertilizer on agricultural land.

16. The columns of the table correspond to the following data types: LS.-NR – delivery note number; Fläche ha – area in hectares; TS ha in to. - total solids in tons per hectare; TS Schlag soll to - tonnage of total solids (maximum amount); TS Schlag ist to tonnage of total solids (actual); Diff. To TS – Difference between the tons of total solids (maximum amount) and tons of total solids (actual); m³/ha - cubic meters of sewage slurry per hectare; m³/stroke - cubic meters per stroke; m³ LS - cubic meters per delivery; TS Schlamm in %- total solids in percent; Abgabetag – date.

17. The data collected in this document relates to sewage slurry samples that I pumped with the Amphi-King at the Neubrunn treatment plant between October 5 and 9, 2010, which I am shown doing in the article of Exhibit B. It is also reflected in the title of the document, which comes from my personal records: TS Neubrunn2010.

18. While the values of the TS Schlamm in % (percentage of total solids) in Exhibit D fluctuate between 5.5% and 16.8%, I also pumped water-sewage slurry mixtures from the Neubrunn treatment plant that were below 5%.

19. I know this because my typical process for pumping sewage slurry lagoons with the Amphi-King involved driving the vehicle into the sewage slurry lagoon and pumping a watery top layer that consisted of a mixture of sewage slurry and water out of the lagoon. After this watery top layer had been pumped out of the lagoon, I mixed the thicker bottom sewage slurry layer with the pump, tires and wheels. After having mixed the thicker lower layer, I pumped the sewage slurry from the thicker lower layer out of the lagoon with the Amphi-King pump. The tested samples documented in the table in Exhibit D were from the thicker bottom layer used to fertilize agricultural fields. This was my approach when operating the Amphi-King at the Neubrunn treatment plant between October 5 and 9, 2010.

VII. AUTHENTICITY OF EXHIBIT E

20. Exhibit E is a true and correct copy of a table with data about a sewage slurry lagoon from which I pumped sewage slurry with the Amphi-King on behalf of UD Umwelt-Dienste before August 2013.

21. This data was collected to comply with the legal requirements for the use of material from sewage slurry lagoons as fertilizer on agricultural land.

22. The columns of the table correspond to the following data types: LS.-NR – delivery note number; Fläche ha – area in hectares; TS ha in to. - total solids in tons per hectare; TS Schlag soll to - tonnage of total solids (maximum amount); TS Schlag ist to tonnage of total solids (actual); Diff. To TS – Difference between the tons of total solids (maximum amount) and tons of total solids (actual); m³/ha - cubic meters of sewage slurry per hectare; m³/stroke - cubic meters per stroke; m³ LS - cubic meters per delivery; TS Schlamm in %- total solids in percent; Abgabetag – date.

23. The data in this document relates to sewage slurry samples that I pumped with the Amphi-King at the Aua treatment plant between April 4 and 21, 2012, which I am shown doing in the video of the screenshots of Exhibit C. This is also reflected in the title of the document, which I obtained from my personal records: TSAua2012.

24. Although the values of the TS Schlamm in % (total solids in percent) in Exhibit D range from 8.8% to 22.4%, I also pumped sewage slurry and water-sewage slurry mixtures from the Aua treatment plant that were below 5%.

25. I know this because my typical process for pumping sewage slurry lagoons with the Amphi-King involved driving the vehicle into the sewage slurry lagoon and pumping a watery top layer that consisted of a mixture of sewage slurry and water out of the lagoon. After this watery top layer had been pumped out of the lagoon, I mixed a thicker bottom sewage slurry layer with the pump. After having mixed the thicker lower layer, I pumped the sewage slurry from the thicker lower layer out of the lagoon with the Amphi-King pump. The tested samples documented in the table in Exhibit E were from the thicker bottom layer used to fertilize agricultural fields. This was my approach when operating the Amphi-King in the Aua treatment plant between April 4 and April 21, 2012.

26. While operating the Amphi-King at the Aua treatment plant between April 4 and April 21, 2012, I also rotated the Amphi-King's wheels to control the speed and direction of the Amphi-King while it was floating in the lagoon. It is mainly controlled with the screw at the rear. Turning the wheels does not only cause the sewage slurry to be mixed, but also potentially a forward or backward movement of the Amphi-King. Turning the wheels on one side of the Amphi-King could also cause the Amphi-King to turn.

VIII. THE AMPHI KING VEHICLE FROM EXHIBIT F

27. I am personally familiar with the Amphi King vehicle and its features. As can be seen from the newspaper articles in Exhibit A and Exhibit B and the screenshots of the UD Umwelt-Dienste marketing video in Exhibit C, I used the Amphi-King on numerous occasions prior to August 2013. In Exhibit F, the Amphi-King amphibious vehicle, that I have personally maneuvered into sewage slurry lagoons, used to agitate sewage slurry lagoons, and used to pump sewage from lagoons for use as fertilizer in agricultural fields, is truthfully and accurately depicted and described as shown and described in Exhibits A-C and as described in this declaration.

28. I personally serviced the Amphi-King pump. When servicing the pump, I personally saw that the pump comprises a housing with a bottom fluid inlet and an impeller connected to a drive shaft to rotate the impeller. I also noted that each of the Amphi-King's wheels was powered by its own motor, and that these independently driven wheels worked together to propel the vehicle.

IX. DESCRIPTION OF THE SERVICES OF UD UMWELT-DIENSTE AND THE USE OF THE AMPHI-KING

29. Until August 2013, while working at UD Umwelt-Dienste, I provided sewage slurry pumping services for UD Umwelt-Dienste customers with the Amphi-King. There were no confidentiality agreements with any of these customers.

30. A list of some of the customers for whom I provided slurry pumping services is attached as Exhibit G. These customers usually included owners of municipal sewage slurry lagoons. I personally performed sewage pumping services with the Amphi-King to all customers with my name (Funck) listed next to them as the “Ausführender” (“Operator”). The facilities for which I provided sewage agitation and pumping services were located near public streets and public places. My use of the Amphi-King was publicly visible to people in these public places and on public streets. Exhibit H, for example, includes an aerial photo that shows the Aua treatment plant and the surrounding roads. The aerial photo included in Exhibit H accurately depicts the layout of the Aua treatment plant and the surrounding roads when I carried out the sewage slurry pumping work with the Amphi-King, as depicted in Exhibit C. I was viewable to anyone using these public roads while I was carrying out the slurry pumping work with the Amphi-King, as depicted in Exhibit C.

31. Although the newspaper from Exhibit A contains a quote that says: “‘The sewage slurry does not contain any feces,’ explains the operator of the frog-like machine, ‘just dead bacteria that the feces previously had previously eaten’” this sewage slurry was not artificially processed. The lagoons did contain human feces. This passage only refers to the naturally occurring bacteria that had an effect on the sewage slurry in the lagoon. This was standard for the sewage slurry lagoons that I pumped with the Amphi-King, including the sewage slurry lagoons shown in Exhibits A-C.

32. The sewage slurry I pumped often contained human feces as well as debris. For example, the sewage slurry often contained debris such as condoms, tampons or toilet paper, which I pumped from the lagoon together with the sewage slurry. This waste also included other natural waste such as reeds, branches or leaves from the areas around the lagoon, which I pumped as well. See e.g., Exhibit C , 8:05. Occasionally, after having pumped the sewage slurry from the lagoon, I also found larger waste in the lagoon such as cooking utensils. After having pumped the sewage slurry from the lagoon, UD Umwelt-Dienste separated the debris from the sewage slurry with a special sieve and dumped the pollutants from the sieve into a pile. An example of such a pile can be seen in the video in Exhibit C at 12:54.



Exhibit C , 12:54 (annotated).

Additional images from my personal records showing this pile of contaminants can be found further below:



33. Prior to August 2013, the slurry pumping services I publicly provided to customers on behalf of UD Umwelt-Dienste with the Amphi-King (including the customers for whom I provided services as listed on Exhibit G) included:

- a. Driving the Amphi-King on the dry land to a sewage slurry lagoon;
- b. Driving the Amphi-King into the sewage slurry lagoon;
- c. Operating the Amphi-King while it was floating within the sewage slurry lagoon
 - i. Rotating the wheels of the Amphi-King as was floating in the sewage slurry lagoon to agitate the slurry and provide propulsion and directional control depending on which wheels are in motion. (see e.g., Exhibit C, 10:20-10:54).
 - ii. Controlling the speed and direction of the Amphi-King while floating in the sewage slurry lagoon with the propeller on the Amphi-King
- d. Pumping sewage slurry in the sewage slurry lagoon, including:

- i. Pumping liquid from close to the surface of the sewage slurry lagoon containing a mixture of sewage slurry and water, the liquid having a total solids content of less than about five percent.
 - ii. Pumping liquid from near the bottom of the sewage slurry lagoon containing a mixture of sewage slurry and water, the liquid having a total solids content of greater than about five percent.
 - iii. Mixing the liquid in the sewage slurry lagoon, which contained a mixture of sewage slurry and water
 - iv. Pumping out the liquid from the sewage slurry lagoon, which contained a mixture of sewage slurry and water
- e. Driving the Amphi-King in the lagoon to the edge of the sewage slurry lagoon;
- f. Driving the Amphi-King onto an embankment at the edge of the sewage slurry lagoon;
- g. Pumping at least a portion of the sewage slurry from the lagoon through at least one hose of the amphibious vehicle, thereby recirculating at least a portion of the sewage slurry in the sewage slurry lagoon;
- h. Controlling the speed of the pump and changing the flow rate of the slurry in the pump of the Amphi-King;
- i. Directing the sewage slurry pumped through the Amphi-King pump nozzle to different locations in the sewage slurry lagoon;
- j. Aiming the slurry pumped through the pump nozzle of the Amphi-King to pump the slurry through the air;

- k. Driving the Amphi-King to the edge of the sewage slurry lagoon and pumping the sewage slurry from the sewage slurry lagoon using the Amphi-King pump connected to a hose;
- l. Moving the crane on which the pump was mounted so that the pump was placed in a position along the bottom of the Amphi-King body and was pumping sewage slurry. In this position, the pump impeller was immersed in the sewage slurry.

X. CERTIFICATION

34. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury under the law of the United States of America that the foregoing is true and correct.

Signature: Eckhard Funck

Name: Eckhard Funck

Date: _____

Ich, Eckhard Funck, erkläre hiermit nach meinem persönlichen Wissen Folgendes:

I. EINLEITUNG

1. Ich bin über 18 Jahre alt. Mein derzeitiger Wohnsitz befindet sich in Nentershausen, Deutschland.
2. Ich bin ehemaliger Mitarbeiter der UD Umwelt-Dienste GmbH („UD Umwelt-Dienste“). Ich war von 2002 bis 2017 bei UD Umwelt-Dienste beschäftigt.
3. Während meiner Tätigkeit bei UD Umwelt-Dienste nutzte ich persönlich das SenwaTec Amphi-King-Fahrzeug („Amphi-King“) zum Abpumpen von Klärschlamm aus Klärteichen. Darüber hinaus war ich persönlich an Marketing- und Werbemaßnahmen im Zusammenhang mit diesen Dienstleistungen beteiligt. Zu diesen Marketing- und Werbeaktivitäten gehörte die Beratung des Marketingteams von UD Umwelt-Dienste und die Zusammenarbeit mit den Marketing- und Vertriebsteams von UD Umwelt-Dienste, um mit den Kunden in Kontakt zu treten und ihre Fragen zu beantworten.
4. Am Ausgang dieses Verfahrens bin ich nicht finanziell interessiert. Für meine Recherchen zu meiner Arbeit für die UD Umwelt-Dienste werde ich mit einem angemessenen Satz von 300 €/Std. entschädigt.

II. HINTERGRUND

5. Nach meiner Erfahrung bestand der Zweck der Marketingmaterialien von UD Umwelt-Dienste vor August 2013 darin, die Öffentlichkeit aufzuklären und die öffentliche Interesse an ihren Dienstleistungen zu wecken. Vor August 2013 war es gängige Geschäftspraxis der UD Umwelt-Dienste, ihre Marketingmaterialien öffentlich zugänglich zu machen, z. B. indem sie diese an Kunden und potenzielle Kunden verteilten, sowie sie auch auf ihre Homepage zugänglich machten. Vor August 2013 erhielten Kunden oder potenzielle Kunden, die

Informationen wie Broschüren, Marketingvideos, Vorführungen auf Kläranlagen und Marketingunterlagen über die Dienstleistungen von UD Umwelt-Dienste unter Verwendung des Amphi-King anforderten, diese Materialien frei und ohne Vertraulichkeitsbeschränkungen. So schilderten beispielsweise vor August 2013 Kunden von UD Umwelt-Dienste gelegentlich Probleme, die sie mit ihren Anlagen hatten. UD Umwelt-Dienste sprach mit den Kunden über diese Probleme und ließ ihnen USB-Sticks mit dem Video in Anlage C zukommen.

6. Bereits vor August 2013 wurde über die Klärschlammpumpleistungen der UD Umwelt-Dienste mit dem Amphi-King in der Presse berichtet. Mehrere dieser Veröffentlichungen zeigen mich persönlich beim Betrieb des Amphi-King und beim Pumpen von Klärschlamm in Klärteichen. *Siehe z. B. Anlage A* (abrufbar unter <https://www.hna.de/lokales/rotenburg-bebra/frosch-vorbild-1376974.html>); *Anlage B* (abrufbar unter <https://www.mainpost.de/regional/main-spessart/gequirilter-klaerschlam-art-5778615>). UD Umwelt-Dienste schätzte die Veröffentlichung seiner Dienstleistungen in den Zeitungen, da sie dazu beitrug, die Aufmerksamkeit der Öffentlichkeit auf die Klärteich-Pumpdienste von UD Umwelt-Dienste zu lenken.

7. Außerdem erstellte UD Umwelt-Dienste eigene Marketingmaterialien, in denen die Klärteich-Räumung (Pumpen und Rausholen) vorgestellt wurden. *Siehe z. B. Anlage C*. Anlage C enthält Screenshots eines Marketingvideos für die Klärteich-Rühr- und Pumpdienste von UD Umwelt-Dienste unter Verwendung des Amphi-King, das vor August 2013 erstellt und öffentlich verbreitet wurde. Ich kenne dieses Marketingvideo persönlich. In Anlage C sind Screenshots von verschiedenen Abschnitten dieses Marketingvideos zu sehen.

III. ECHTHEIT UND ÖFFENTLICHE ZUGÄNLICHKEIT VON ANLAGE A

8. Bei Anlage A handelt es sich um eine wahrheitsgetreue und korrekte Kopie eines Zeitungsartikels mit dem Titel *Der Frosch als Vorbild* vom 25. August 2011, in dem wahrheitsgemäß und genau dargestellt und beschrieben wird, wie ich den Amphi-King in einem Klärteich betreibe, während ich Klärschlamm abpumpe. Während meiner Einsätze mit dem Amphi-King, der in diesem Zeitungsartikel vom 25. August 2011 gezeigt wird, manövrierte ich den Amphi-King vom Land über das Ufer des Klärteichs in den Klärteich. Mit der Pumpe und der Düse und der Schraube und den Rädern des Amphi-King rührte und mischte ich den Klärschlamm. Wenn das Abwasser ausreichend aufgewirbelt war, schloss ich einen Schlauch an die Amphi-King-Pumpe an und pumpte das Abwasser mit dem Amphi-King aus dem Klärteich.

IV. ECHTHEIT UND ÖFFENTLICHE ZUGÄNLICHKEIT VON ANLAGE B

9. Bei Anlage B handelt es sich um eine wahrheitsgetreue und korrekte Kopie eines Zeitungsartikels mit dem Titel *Gequirilter Klärschlamm* vom 15. Oktober 2010, in dem wahrheitsgemäß und genau dargestellt und beschrieben wird, wie ich den Amphi-King in einem Klärteich betreibe und Klärschlamm abpumpe. Während meiner Einsätze mit dem Amphi-King, der in diesem Zeitungsartikel vom 15. Oktober 2010 gezeigt wird, manövrierte ich den Amphi-King vom Land über das Ufer des Klärteichs in den Klärteich. Mit der Pumpe und der Düse und der Schraube und den Rädern des Amphi-King rühre und mische ich den Klärschlamm. Wenn das Abwasser ausreichend aufgewirbelt war, schloss ich einen Schlauch an die Amphi-King-Pumpe an und pumpte das Abwasser mit dem Amphi-King aus dem Klärteich.

V. ECHTHEIT UND ÖFFENTLICHE ZUGÄNLICHKEIT VON ANLAGE C

10. Bei Anlage C handelt es sich um eine wahrheitsgetreue und korrekte Kopie einer Zusammenstellung von Screenshots eines Marketingvideos, das von UD Umwelt-Dienste vor

August 2013 für die betroffene Öffentlichkeit und Kunden veröffentlicht wurde. Die in Anlage C gezeigten Screenshots geben wahrheitsgetreu und genau das Marketingvideo von UD Umwelt-Dienste wieder. Darin wird gezeigt, wie ich im April 2012 den Amphi-King in einem Klärteich betreibe und Klärschlamm abpumpe.

11. UD Umwelt-Dienste hat das in Anlage C dargestellte Marketingvideo vor dem 7. Mai 2012 erstellt. Ich weiß, dass das in Anlage C dargestellte Video vor dem 7. Mai 2012 erstellt wurde, da dieses Marketingvideo zwischen dem 7. und 11. Mai 2012 auf der IFAT-Messe in München gezeigt wurde. Die IFAT ist eine große Fachmesse für Wasser-, Abwasser-, Abfall- und Rohstoffwirtschaft. Ich schätze, dass im Jahr 2012 etwa 100.000 Menschen die IFAT-Messe besucht haben.

12. Ich habe persönlich gesehen, wie dieses Video auf der IFAT-Messe im Mai 2012 auf den Fernsehern am Stand von UD Umwelt-Dienste abgespielt wurde. Hunderte von Messebesuchern gingen an dem Stand vorbei und sahen das Video, das abgespielt wurde. Eine Kopie dieses Videos wurde später auf YouTube hochgeladen und ist unter folgendem Link zu finden: <https://www.youtube.com/watch?v=ecnlfMf7CH4&t=1s>. Das unter diesem Link gezeigte Video ist das gleiche Video, das auf der IFAT-Messe im Mai 2012 öffentlich gezeigt wurde.

13. Im Anschluss an die IFAT-Messe und noch vor August 2013 wurden USB-Sticks mit einer Kopie des Videos an viele interessierte Kunden von UD Umwelt-Dienste verschickt, unter anderem und ohne Einschränkung an die EWE Wasser GmbH. Für diejenigen, die das Video auf der IFAT-Messe gesehen oder später eine Kopie davon erhalten haben, gab es keine Vertraulichkeitsbeschränkungen.

VI. ECHTHEIT VON ANLAGE D

14. Bei Anlage D handelt es sich um eine wahrheitsgetreue und korrekte Kopie einer Tabelle mit Daten zu einem Klärteich, aus dem ich vor August 2013 im Auftrag von UD Umwelt-Dienste Klärschlamm mit dem Amphi-King abgepumpt habe.

15. Diese Daten wurden erhoben, um die gesetzlichen Bestimmungen für die Verwendung von Material aus Klärteichen als Düngemittel auf landwirtschaftlichen Flächen zu erfüllen.

16. Die Spalten der Tabelle entsprechen den folgenden Datentypen: LS.-NR – Lieferscheinnummer; Fläche ha - Fläche in Hektar; TS ha in to. - Trockensubstanz in Tonnen pro Hektar; TS Schlag soll to - Gesamttonnage an Trockensubstanz (maximale Menge); TS Schlag ist to - Gesamttonnage an Trockensubstanz (tatsächlich); Diff. To TS - Differenz zwischen Gesamttonnen Trockensubstanz (maximale Menge) und Gesamttonnen Trockensubstanz (tatsächlich); m³/ha - Kubikmeter Klärschlamm pro Hektar; m³/Schlag - Kubikmeter pro Schlag; m³ LS - Kubikmeter pro Anlieferung; TS Schlamm in % - Trockensubstanz in Prozent; Abgabetag - Datum.

17. Die in diesem Dokument gesammelten Daten beziehen sich auf Proben von Klärschlamm, die ich zwischen dem 5. und 9. Oktober 2010 in der Kläranlage Neubrunn mit dem Amphi-King gepumpt habe, wie im Artikel von Anlage B dargestellt. Dies spiegelt sich auch im Titel des Dokuments wider, der aus meinen persönlichen Unterlagen stammt: TS Neubrunn2010.

18. Während die Werte der TS Schlamm in % (Trockensubstanzprozent) in Anlage D zwischen 5,5 % und 16,8 % schwanken, habe ich während dieser Räumung auch Wasser-Klärschlamm- Gemische aus der Kläranlage Neubrunn gepumpt, die unter 5 % lagen.

19. Das weiß ich, weil ich üblicherweise beim Abpumpen von Klärteichen mit dem Amphi-King mit dem Fahrzeug in den Klärteich hineinfuhr und eine wässrige Oberschicht aus einem Gemisch von Klärschlamm und Wasser aus dem Teich pumppte. Nachdem diese wässrige obere Schicht aus dem Klärteich gepumpt wurde, mischte ich die dickere untere Schicht aus Klärschlamm mit der Pumpe, Reifen und Räder. Nach dem Durchmischen der dickeren unteren Schicht pumppte ich den Klärschlamm der dickeren unteren Schicht mit der Pumpe des Amphi-King aus dem Klärteich. Die gemessenen und in der Tabelle in Anlage D dokumentierten Proben stammten aus der dickeren unteren Schicht, die zum Düngen von landwirtschaftlichen Feldern verwendet wurde. Dies war meine Vorgehensweise beim Betrieb des Amphi-King in der Kläranlage Neubrunn zwischen dem 5. und 9. Oktober 2010.

VII. ECHTHEIT VON ANLAGE E

20. Bei Anlage E handelt es sich um eine wahrheitsgetreue und korrekte Kopie einer Tabelle mit Daten zu einem Klärteich, aus dem ich vor August 2013 im Auftrag von UD Umwelt-Dienste Klärschlamm mit dem Amphi-King abgepumpt habe.

21. Diese Daten wurden erhoben, um die gesetzlichen Bestimmungen für die Verwendung von Material aus Klärteichen als Düngemittel auf landwirtschaftlichen Flächen zu erfüllen.

22. Die Spalten der Tabelle entsprechen den folgenden Datentypen: LS.-NR – (Lieferscheinnummer); Fläche ha - Fläche in Hektar; TS ha in to. - Trockensubstanz in Tonnen pro Hektar; TS Schlag soll to - Gesamttonnage an Trockensubstanz (maximal); TS Schlag ist to - Gesamttonnage an Trockensubstanz (tatsächlich); Diff. To TS - Differenz zwischen Gesamttonnen Trockensubstanz (maximal) und Gesamttonnen Trockensubstanz (tatsächlich); m³/ha - Kubikmeter Klärschlamm pro Hektar; m³/Schlag - Kubikmeter pro Schlag; m³ LS -

Kubikmeter pro Anlieferung; TS Schlamm in % - Trockensubstanz in Prozent; Abgabetag - Datum. Am rechten Tabellenrand stehen zusätzlich die Namen der Landwirte, an welche die UD Umwelt-Dienste Klärschlamm geliefert hat.

23. Die in diesem Dokument gesammelten Daten beziehen sich auf Proben von Klärschlamm, die ich zwischen dem 4. und 21. April 2012 in der Kläranlage von Aua mit dem Amphi-King gepumpt habe, wie in dem Video in den Screenshots von Anlage C zu sehen ist. Dies spiegelt sich auch im Titel des Dokuments wider, den ich aus meinen persönlichen Unterlagen erhalten habe: TSAua2012.

24. Obwohl die Werte der TS Schlamm in % (Trockensubstanz in Prozent) in Anlage D zwischen 8,8 % und 22,4 % schwanken, habe ich während dieser Räumung auch Klärschlamm- und Wasser- Klärschlamm-Gemische aus der Aua-Kläranlage gepumpt, die unter 5 % lagen.

25. Das weiß ich, weil ich üblicherweise beim Abpumpen von Klärteichen mit dem Amphi-King mit dem Fahrzeug in den Klärteich hineinfuhr und eine wässrige Oberschicht aus einem Gemisch von Klärschlamm und Wasser aus dem Teich pumpte. Nachdem diese wässrige obere Schicht aus dem Klärteich gepumpt wurde, mischte ich eine dickere untere Schicht aus Klärschlamm mit der Pumpe. Nach dem Durchmischen der dickeren unteren Schicht pumpte ich den Klärschlamm der dickeren unteren Schicht mit der Pumpe des Amphi-King aus dem Klärteich. Die gemessenen und in der Tabelle in Anlage E dokumentierten Proben stammten aus der dickeren unteren Schicht, die zum Düngen von landwirtschaftlichen Feldern verwendet wurde. Dies war meine Vorgehensweise beim Betrieb des Amphi-King in der Kläranlage Aua vom 4. bis 21. April 2012.

26. Während des Betriebs des Amphi-King in der Kläranlage von Aua zwischen dem 4. und 21. April 2012 drehte ich auch die Räder des Amphi-King, um die Geschwindigkeit und Richtung des im Klärteich schwimmenden Amphi-King zu steuern. Gesteuert wird vor allem mit der Schraube am Heck. Das Drehen der Räder führte aber nicht nur zur Vermischung des Klärschlammes, sondern konnte auch zu einer Vor- oder Rückwärtsbewegung des Amphi-King führen. Das Drehen der Räder auf einer Seite des Amphi-Kings konnte auch zu einer Wendung des Amphi-King führen.

VIII. DAS AMPHI-KING-FAHRZEUG VON ANLAGE F

27. Ich bin persönlich mit dem Amphi-King-Fahrzeug und seinen Eigenschaften vertraut. Wie aus den Zeitungsartikeln in Anlage A und Anlage B sowie aus den Screenshots des Marketingvideos von UD Umwelt-Dienste in Anlage C ersichtlich ist, habe ich den Amphi-King bei zahlreichen Gelegenheiten vor August 2013 benutzt. In Anlage F wird das Amphi-King-Amphibienfahrzeug, das ich persönlich in Klärteiche manövriert, zum Umrühren von Klärteichen und zum Abpumpen von Abwässern aus Klärteichen zur Verwendung als Dünger auf landwirtschaftlichen Feldern verwendet habe, wahrheitsgemäß und genau dargestellt und beschrieben, wie in den Anlagen A-C dargestellt und beschrieben und wie in dieser Erklärung beschrieben ist.

28. Ich habe die Amphi-King-Pumpe persönlich gewartet. Bei der Wartung der Pumpe habe ich persönlich gesehen, dass die Pumpe ein Gehäuse mit einem unteren Flüssigkeitseinlass und einem Laufrad umfasst, das mit einer Antriebswelle verbunden ist, um das Laufrad in Drehung zu versetzen. Ich habe auch festgestellt, daß jeder der Räder des Amphi-King von einem eigenen Motor angetrieben wurde, und daß diese unabhängig angetriebenen Räder zusammenarbeiteten, um das Fahrzeug anzutreiben.

IX. BESCHREIBUNG DER DIENSTLEISTUNGEN VON UD UMWELT-DIENSTE UND DER NUTZUNG DES AMPHI-KING

29. Bis August 2013 erbrachte ich während meiner Tätigkeit bei UD Umwelt-Dienste Klärschlammumpumpdienste für Kunden der UD Umwelt-Dienste mit dem Amphi-King. Es gab keine Vertraulichkeitsvereinbarungen mit einem dieser Kunden.

30. Eine Liste einiger Kunden, für die ich Klärschlammumpumpdienste erbracht habe, ist als Anlage G beigefügt. Zu diesen Kunden gehörten in der Regel Besitzer von kommunalen Klärteichen. Ich habe persönlich allen Kunden, neben denen mein Name (Funck) als "Ausführender" aufgeführt ist, Abwasserpumpdienste mit dem Amphi-King durchgeführt. Die Einrichtungen, für die ich Abwasserrühr- und -pumpdienste erbrachte, befanden sich in der Nähe öffentlicher Straßen und Plätze. Meine Nutzung des Amphi-King war für die Menschen an diesen öffentlichen Orten und auf öffentlichen Straßen öffentlich sichtbar. In Anlage H ist beispielsweise ein Luftbild der Kläranlage von Aua und der umliegenden Straßen zu sehen. Das in Anlage H enthaltene Luftbild zeigt genau den Grundriss der Kläranlage von Aua und der umliegenden Straßen, als ich die Klärschlammumpumparbeiten mit dem Amphi-King durchführte (siehe Anlage C). Ich war für die Verkehrsteilnehmer auf diesen öffentlichen Straßen sichtbar, als ich die Klärschlammumpumparbeiten mit dem Amphi-King durchführte (siehe Anlage C).

31. Obwohl die Zeitung von Anlage A ein Zitat enthält, in dem es heißt: "Es sind ja keine Fäkalien, die in dem Klärschlamm enthalten sind", erklärt der Fahrzeugführer der froschartigen Maschine, 'sondern es sind lediglich abgestorbene Bakterien, die die Fäkalien zuvor aufgefressen haben'. Dieser Klärschlamm wurde nicht künstlich aufbereitet. Die Klärteiche enthielten schon menschliche Fäkalien. Diese Passage bezieht sich lediglich auf die natürlich vorkommenden Bakterien, die auf den Klärschlamm im Klärteich eingewirkt hatten.

Dies war bei den Klärschlammteichen, die ich mit dem Amphi-King gepumpt habe, die Standard-Vorgehensweise, so auch bei den Klärteichen, die in den Anlagen A-C dargestellt sind.

32. Der von mir gepumpte Klärschlamm enthielt häufig neben menschlichen Fäkalien auch Verunreinigungen. Zum Beispiel enthielt der Klärschlamm oft Verunreinigungen wie Kondome, Tampons und Toilettenpapier, die ich mit dem Klärschlamm aus dem Klärteich gepumpt habe. Zu diesen Abfällen gehörten auch andere natürliche Abfälle wie Schilf, Äste und Blätter von den Flächen rund um den Klärteich, das ich ebenfalls abpumpte. *Siehe z. B. Anlage C*, 8:05. Gelegentlich fand ich nach dem Abpumpen des Klärschlammes aus dem Klärteich auch größere Abfälle im Klärteich, wie z. B. Kochutensilien. Nach dem Abpumpen des Klärschlammes aus dem Klärteich trennte UD Umwelt-Dienste den Schmutz mit einem speziellen Sieb vom Klärschlamm ab und kippte den Abfall aus dem Sieb auf einen Haufen. Ein Beispiel für einen solchen Abfallhaufen ist im Video von Anlage C bei 12:54 zu sehen.



Anlage C, 12:54 (mit Anmerkungen).

Weitere Bilder aus meinen persönlichen Unterlagen, die diesen Abfallhaufen zeigen, finden Sie weiter unten:



33. Vor August 2013 gehörten zu den Klärschlammumpfdiensten, die ich im Auftrag von UD Umwelt-Dienste öffentlich für Kunden erbracht habe, die den Amphi-King benutzen (einschließlich der Kunden, für die ich Dienstleistungen erbracht habe, wie in Anlage G aufgeführt):

- a. Fahren des Amphi-King auf dem Boden zu einem Klärteich;
- b. Fahren des Amphi-King in den Klärteich;
- c. Fahren des Amphi-King, während er im Klärteich schwimmt
 - i. Drehen der Räder des Amphi-King, während er im Klärteich schwimmt, um den Klärschlamm umzurühren sowie den Antrieb und die

Richtungssteuerung zu gewährleisten, je nachdem, welche Räder in Bewegung sind. (siehe z. B. Anlage C, 10:20-10:54).

- ii. Steuern der Geschwindigkeit und Richtung des Amphi-Kings während des Schwimmens im Klärteich mit Hilfe des Propellers am Amphi-King
- d. Pumpen von Klärschlamm im Klärteich, einschließlich:
 - i. Pumpen von Flüssigkeit aus der Nähe der Oberfläche des Klärteichs, die ein Gemisch aus Klärschlamm und Wasser enthält, wobei die Flüssigkeit einen Gesamtfeststoffgehalt von weniger als etwa fünf Prozent aufweist.
 - ii. Pumpen von Flüssigkeit aus der Nähe des Bodens des Klärteichs, der ein Gemisch aus Klärschlamm und Wasser enthält, wobei die Flüssigkeit einen Gesamtfeststoffgehalt von mehr als etwa fünf Prozent aufweist.
 - iii. Vermischen der Flüssigkeit im Klärteich, die ein Gemisch aus Klärschlamm und Wasser enthielt
 - iv. Abpumpen der Flüssigkeit aus dem Klärteich, die ein Gemisch aus Klärschlamm und Wasser enthielt
- e. Fahren des Amphi-King im Klärteich bis zum Rand des Klärteichs;
- f. Fahren des Amphi-King auf eine Böschung am Rande des Klärteichs;
- g. Pumpen mindestens eines Teils des Klärschlammes aus dem Klärteich durch mindestens eine Leitung des Amphibienfahrzeugs, wodurch mindestens ein Teil des Klärschlammes im Klärteich rezirkuliert wurde;
- h. Steuern der Drehzahl der Pumpe und Ändern der Durchflussmenge des Klärschlammes in der Pumpe des Amphi-King;

- i. Richten des durch die Pumpendüse des Amphi-King gepumpten Klärschlammes auf verschiedene Stellen im Klärteich;
- j. Ausrichten des durch die Pumpendüse des Amphi-King gepumpten Klärschlammes, um den Klärschlamm durch die Luft zu pumpen um zu rühren;
- k. Fahren des Amphi-King an den Rand des Klärteichs und Abpumpen des Klärschlammes aus dem Klärteich mit Hilfe der an einen Schlauch angeschlossenen Amphi-King-Pumpe;
- l. Bewegen des Krans, an dem die Pumpe montiert war, so dass die Pumpe in einer Position entlang der Unterseite des Amphi-King-Körpers angeordnet war und Klärschlamm pumpte. In dieser Position war das Pumpenlaufrad in den Klärschlamm eingetaucht.

X. BESCHEINIGUNG

34. Hiermit bestätige ich, dass alle hierin gemachten Angaben nach meinem eigenen Wissen der Wahrheit entsprechen und dass alle Angaben, die ich nach bestem Wissen und Gewissen gemacht habe, der Wahrheit entsprechen und dass diese Angaben in Kenntnis der Tatsache gemacht wurden, dass vorsätzliche Falschaussagen und dergleichen gemäß 18 U.S.C. § 1001 mit Geld- oder Freiheitsstrafe oder beidem geahndet werden. Ich versichere unter Androhung einer Strafe wegen Meineids nach dem Recht der Vereinigten Staaten von Amerika, dass das Vorstehende wahr und richtig ist.

Unterschrift: Eckhard Funck

Name: Eckhard Funck

Datum: 8.3.2024

EXHIBIT A

- Anzeige -



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Startseite > Lokales > Rotenburg / Bebra

Der Frosch als Vorbild

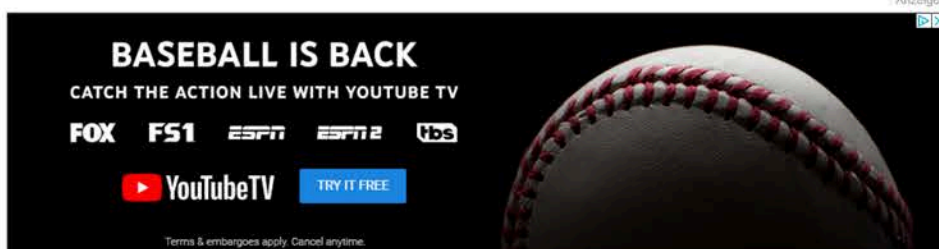
25.08.2011, 17:15 Uhr

 Kommentare Drucken  Teilen

Mit den Bewegungen einer Amphibie: Eckhard Funck reinigt fahrend und schwimmend den Klärteich in Mecklar mit einer neuen und umweltfreundlichen Technik. Sein froschartiges Gerät leistet 60 Pferdestärken. Foto: Kaschik © -

ludwigsau. Ihm stinkt sein Beruf nicht. Mit einem Amphibienfahrzeug fährt Eckhard Funck durch den Klärteich bei Mecklar und beseitigt den Schlamm, der sich innerhalb der vergangenen Jahre dort angesammelt hat.

Durch diese Methode ist die UD Umweltdienste GmbH ein Vorreiter der umweltfreundlichen Klärteich-Säuberung. „Unsere Methode ist CO₂-neutral, kostensparend und schnell“, erklärt UD-Pressesprecher Benedikt Hauer.



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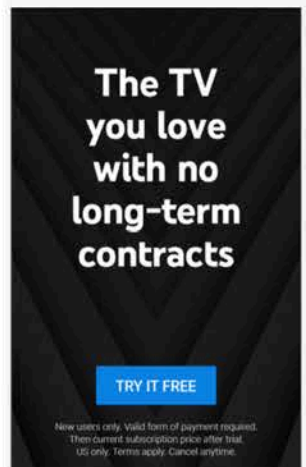


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Und auch der technische Leiter zeigt sich begeistert: „Das ist auf jeden Fall angenehmer als früher und auf dem Konto riecht man ja nicht, womit man sein Geld verdient“, lacht Eckhard Funck.

Wenn nicht der leicht modrige Geruch in der Luft liegen würde, könnte man denken, Eckhard Funck dreht seine Runden in einem Boot auf dem kleinen See inmitten der Felderlandschaft Mecklars.

- Anzeige -



The advertisement banner for YouTube TV features a dark background with a diagonal pattern. On the left is the YouTube TV logo with a red play button icon. Below it is a blue button that says "TRY IT FREE". To the right, the text "Enjoy live TV like cable with YouTube TV" is displayed in white. Below this text are the logos for CBS, abc, ESPN, FOX, and NBC. At the bottom, in small white text, it says: "New users only. Valid form of payment required. Then current subscription price after trial. US only. Terms apply. Cancel anytime."

So ganz fern ist dieser Gedanke nicht: „Es sind ja keine Fäkalien, die in dem Klärschlamm enthalten sind“, erklärt der Fahrzeugführer der froschartigen Maschine, „sondern es sind lediglich abgestorbene Bakterien, die die Fäkalien zuvor aufgefressen haben.“ Somit ist das, was in dem Teich schwimmt, alles andere als Toilettenabfall.

Ludwigsaus Bürgermeister Thomas Baumann ist überzeugt von dieser Methode. „Unsere Äcker können ohne weite Transportwege mit dem phosphatreichen Schlamm gedüngt werden.“ Vom Klärteich kann der Düngschlamm direkt auf die umliegenden Felder gefahren werden. Mit einem speziellen Düngefahrzeug wird der Schlamm auf den Feldern verteilt.

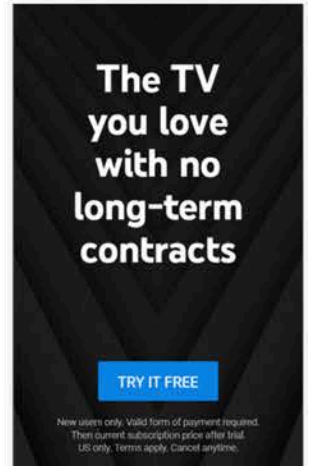
Akribische Sorgfalt

„Was hier so simpel und schnell erscheint, ist ein immenser bürokratischer Aufwand“, erklärt Thomas Baumann. Für jedes Feld wird ein eigener kleiner Bauantrag gestellt, die Landwirte müssen informiert werden und zustimmen. Letztendlich muss der Schlamm noch regelmäßig geprüft werden, damit keine Schadstoffe in die Landwirtschaft geraten.

Zusätzlich werden auch die Felder kontrolliert, damit sie nicht willkürlich gedüngt werden und sich unter den biologischen Dünger noch künstliche Stoffe mischen.

Lohnender Papierkrieg

Doch dieser Papierkrieg lohnt sich nicht nur allein der Umwelt zuliebe, sondern auch für den Geldbeutel der Mecklaer Bürger. Etwa die Hälfte der sonstigen Abwassergebühren wird gespart, lediglich rund vier bis fünf Euro pro Einwohner fallen im Jahr an Kosten an.



The advertisement features a dark background with a large, stylized white 'V' shape. Inside the 'V', the text "The TV you love with no long-term contracts" is written in white. Below this is a blue button that says "TRY IT FREE". At the bottom, in small white text, it says: "New users only. Valid form of payment required. Then current subscription price after trial. US only. Terms apply. Cancel anytime."

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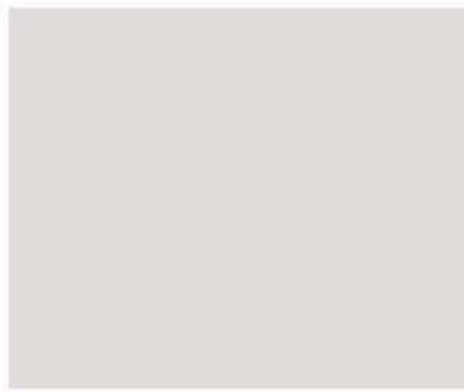
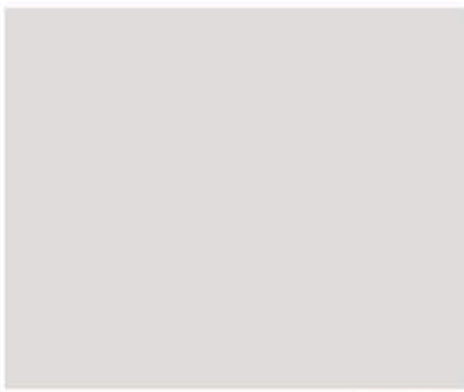


Fünf Arbeitstage

Innerhalb von fünf Arbeitstagen wird der Schlamm gelockert, homogenisiert und auf den Feldern verteilt. Dann ist der Klärteich wieder gesäubert. „Natürlich wird auch etwas CO₂ verbraucht“, erklärt Benedikt Hauer, „die Maschinen verbrauchen schließlich Energie.“

Um diese minimale Umweltbelastung auszugleichen, werden zusätzliche Bäume gepflanzt, die das ökologische Gleichgewicht halten.

Von Johanna Kaschik



Kommentare

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EXHIBIT B

NEUBRUNN

Gequirilter Klärschlamm



Redaktion

15.10.2010 | aktualisiert: 15.10.2010 17:24 Uhr

(a) nk) In der Marktgemeinde Neubrunn mit Ortsteil Böttigheim wurde in den beiden Kläranlagen je ein Klärbecken gereinigt. Die Gemeinde beauftragte damit die Spezialfirma „DU Umweltdienste GmbH“ aus Rinnthal, die mit neuartigem Spezialgerät anrückte. Diese Firma ist eine Tochtergesellschaft des hessischen Bauernverbandes und seit fast 25 Jahren in der Klärschlammmentsorgung tätig.



Foto: Andrea Kemmer | Aufwühlender Job: Eckhard Funck quirilt den Schlamm im Becken der Kläranlage Neubrunn mit seinem Amphibienfahrzeug auf, um ihn dann abzusaugen.

Mit seinen 80 PS starken Amphibienfahrzeug mit Auslegepumpe, welches in Neubrunn zum ersten Mal zum Einsatz kam, pflügte Eckhard Funck durch die schwarze Brühe. Dabei quirlte er mittels eines Aufwühlers an der Auslegepumpe und einer Schiffsschraube am Fahrzeugende sorgfältig Wasser und Schlamm. Je weniger Wasser im Teich ist, desto wichtiger ist das Umrühren, schließlich soll die ganze Angelegenheit schön flüssig bleiben. Dann kuppelte er einen Schlauch an die Auslegepumpe und beförderte den aufgewühlten Schlamm in das Transportfass an einem Bulldog. Dieser brachte den Klärschlamm auf landwirtschaftliche Flächen aus, wo er untergearbeitet wurde. Der Klärschlamm hat gute Düngewirkung.

Bevor der Klärschlamm jedoch auf landwirtschaftliche Flächen ausgebracht werden darf, müssen der Schlamm und auch der Boden sorgfältig auf ihre Werte untersucht werden. Wo der Schlamm bleibt, wie er verwertet und kontrolliert wird – all das muss die Firma dokumentieren und der Gemeinde vorlegen.

Nichts mehr verpassen: [Abonnieren Sie den Main-Spessart-Newsletter](#) und zweimal in der Woche per E-Mail, welche Themen Main-Spessart und die F bewegen.

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HAMMELBURG

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EXHIBIT C





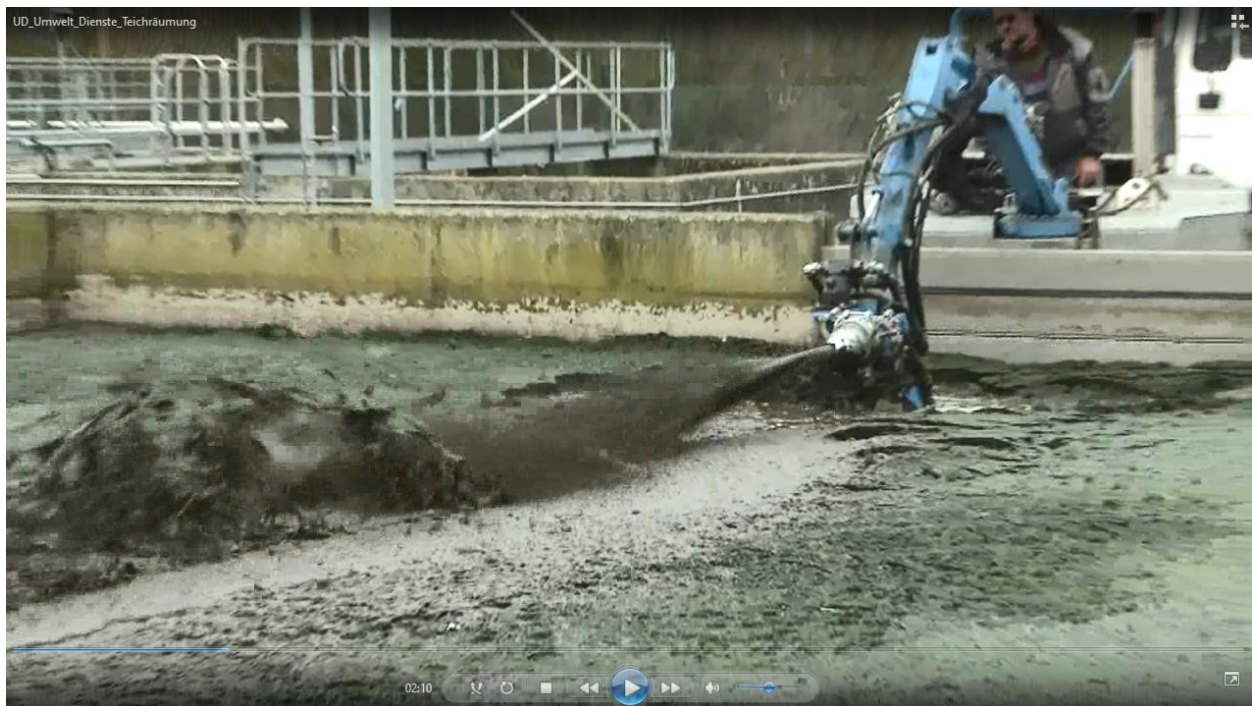






EXHIBIT D

LS.-NR	Fläche ha	TS ha in to.	TS Schlag soll to	TS Schlag ist to	Diff. To TS	m³/ ha	m³/Schlag	m³ LS	TS Schlamm in %	Abgabetag
20325	0,7504	3,9300	2,9491	2,9425	0,0066	71,0	53,28	53,5	5,5%	05. Okt
20328	4,6547	3,9300	18,2930	18,2885	0,0045	49,0	228,08	231,5	7,9%	06. Okt
21383	1,3775	4,3000	5,9233	5,9040	0,0192	52,0	71,63	72	8,2%	07. Okt
20333	1,3058	3,9300	5,1318	5,1250	0,0068	47,0	61,37	62,5	8,2%	07. Okt
21382	2,2375	4,3000	9,6213	9,5940	0,0272	52,0	116,35	117	8,2%	07. Okt
21381	2,6035	4,3000	11,1951	11,1930	0,0020	52,0	135,38	136,5	8,2%	07. Okt
20346	0,8018	3,9300	3,1511	3,1350	0,0161	71,0	56,93	57	5,5%	05. Okt
20348	2,6355	3,9300	10,3575	10,3020	0,0555	38,0	100,15	101	10,2%	08. Okt
20349	3,0276	3,9300	11,8985	11,8320	0,0665	38,0	115,05	116	10,2%	08. Okt
20352	1,7771	3,9300	6,9840	6,8880	0,0960	23,0	40,87	41	16,8%	09. Okt
21379	2,4305	4,3000	10,4512	10,4040	0,0471	42,0	102,08	102	10,2%	08. Okt
21380	2,1451	4,3000	9,2239	9,1560	0,0679	25,5	54,70	54,5	16,8%	09. Okt
22117	0,9170	4,3000	3,9431	3,8640	0,0791	25,5	23,38	23	16,8%	09. Okt
22118	1,9244	4,3000	8,2749	8,2555	0,0194	54,0	103,92	104,5	7,9%	06. Okt
22120	1,5106	4,3000	6,4956	6,4680	0,0276	25,5	38,52	38,5	16,8%	09. Okt
22122	1,3494	4,2000	5,6675	5,6280	0,0395	25,5	34,41	33,5	16,8%	09. Okt
22124	2,4385	4,1000	9,9979	9,9960	0,0018	42,0	102,42	98	10,2%	08. Okt
22125	1,5434	4,3000	6,6366	6,5520	0,0846	25,5	39,36	39	16,8%	09. Okt
Gesamt	35,4303		146,1951	145,5275	0,6676		1477,88	1481	-3,12	
Datum	18 m³	16 m³	16 m³	0m³	Gesamt	TS/Tag	toTS/Tag	Vor Ort TS		
05. Okt 10	126,00	0,00	0,00		126,00	5,50	6,93	0		
06. Okt 10	306,00				306,00	7,90	24,17	0		
07. Okt 10	288,00	80,00	80,0000		448,00	8,20	36,74	0		
08. Okt 10	180,00	128,00	128,0000		436,00	10,20	44,47			
09. Okt 10	72,00	64,00	48,00		184,00	16,80	30,91			
			0,00		0,00	5,50	0,00			
	972,0000	272,0000	256,0000	SOLL	1481,00		143,22			
				IST	1500,00					
				DIFF.	-19,00					

2,21368										
0,7504	2,9500									
1	X									
3,931236674										

EXHIBIT E

EXHIBIT F



40 YEARS OF EXPERIENCE IN THE DEVELOPMENT OF:

- *DITCH CLEANER AND SLOPE MOWERS*
- *MOWING AND CLEARING BOATS*
- *WEED HARVESTERS*
- *AMPHIBIOUS VEHICLES*
- *CUTTER SUCTION AND EXCAVATING DREDGES*

SCHRÖER ENVIRONMENT AND WATER TECHNOLOGY

Light Amphibious Boat/Vehicle

"Amphi-King®" SWT-AB380

- ❖ Light and strong aluminum construction, approximately 2480 kg (5,500 lbs.), without attachments
- ❖ 6-wheel drive or track drive system (track drives are patented system)
- ❖ Forward crane ready for many attachments with available power for up to 50 KW (67 HP)
- ❖ Heavy duty Diesel engine certified to the latest standards of Tier IV emission and fuel consumption
- ❖ Optimal configuration of power requirements and hydraulic unit (less operating costs)
- ❖ Low ground pressure and good clearance on terrain, marches and swamps during on-land drives
- ❖ Shallow vessel draft with, low center of gravity for safe on-water maneuvering
- ❖ High working range and wide swing radius of the hydraulic crane arm, ready for many attachments
- ❖ Operating controls conveniently placed and adjustable to suite operator's seat position
- ❖ Vehicle construction & safety configuration according to European & International standards



A compact muscular vehicle with tracks

With a powerful centrifugal pump and 8" suction- and 6" discharge ports, hydraulically driven, delivering 40 kW of pumping power



6-Wheel driven unit with stabilizer pontoons



- Ergonomic arrangement of the operating and monitoring elements



-A compact transport package on the tilt deck trailer

Equipment Attachment, Working Tools, Features:



- Optional 6-wheel drive version shown, for reduced ground pressure
- Powerful wheel / track drives for banks & slopes of up to 30°
- Stable forward crane with slew ring for 270° swing (135° per side)



- Hydraulic auger propulsion, depth adjustable, c/w:
- Swing steering & power tilt for easy maintenance-
- Auger counter cutter for no-wrap weed clearing

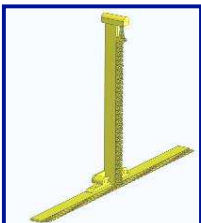
Tilt-deck trailer c/w low deck, on-off ramp & electro-hydraulic power pack



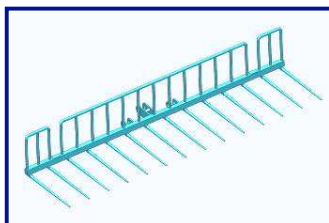
Capacities and Dimensions:

- GVRW : 3500 kg (7,700 lbs.) Load capacity: 2570 kg (5,660 lbs.)
- Box length: 4,48 m (14'-6") Side height: 20 cm (8")
- Deck height: 68 cm (27") Length overall : 6,21 (20'-5")
- Width overall: 2,44 m (8'-0")
- Finish: Aluminum and hot-dip galvanized.
- Sides are removable to full deck width of 2,44 m (8'-0")

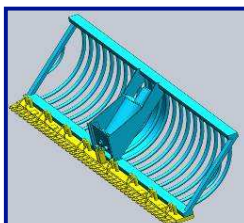
Available working tools and attachment units:



T-Shaped Cutter-Bar



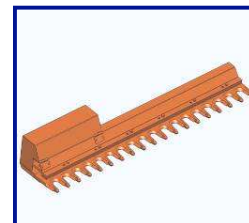
Clearing & Collecting Rake



Mowing Bucket



Excavating Bucket



Tree Cutter



Equipped with suction auger for sludge



Suction an pumping of swimming algae and weeds

Specifications

	<i>Amphi-King® SWT-AB380 (with 6-wheel-drive)</i>	<i>Amphi-King® SWT-AB380-RF (with track-drives)</i>
<u>Dimensions,</u> Compact: Hull: Shipping: Material: Draft: Freeboard: Weights:	L x W x H: 3,80 m x 2,35 m x 1,35 m (12'-5" x 6'-7" x 4'-5") L x W x H: 3,80 m x 1,25 m x 1,00 m (12'-5" x 4'-2" x 3'-4") L x W x H: 4,30 m x 2,35 m x 1,50 m (14'-2" x 6'-7" x 4'-11") Robust marine aluminum construction Average @ 55 cm (22") below hull, Approximately 45 cm (18") Approximately 2350 kg (5,200 lbs.), without attachments	L x W x H: 3,80 m x 2,35 m x 1,35 m (12'-5" x 7'-9" x 4'-5") L x W x H: 3,80 m x 1,25 m x 1,00 m (12'-5" x 4'-2" x 3'-4") L x W x H: 4,30 m x 2,35 m x 1,50 m (14'-2" x 7'-9" x 4'-11") Robust marine aluminum construction Average @ 55 cm (22") below hull, with Approximately 45 cm (18") Approximately 2480 kg (5,500 lbs.), without attachments
Drive Wheels and Tracks:	6-wheel vehicle, tires ø 92 cm (36") x 32 cm (12.6") wide, Alternate tire width: 42 cm (16.5")	Vehicle tracks (2) @ 50 cm (20") width driven by four (4) powerful high torque hydraulic motors
Crane Capacity:	❖ Length of 2,40 m (7'-10"), working depth up to 1,20 m (47") below water level, load height up to 2,00 m (6'-7") Slewing ring swing range 270°. Lift capacity: boom stretched out: 320 kg; boom closest to vehicle: 550 kg	
Engine:	❖ Powerful Diesel engine with 55 KW/74 HP @ 2200 RPM, temperature & oil pressure monitoring system	
Hydraulics System:	❖ <u>Track / Wheel drive mechanism:</u> Transmission over variable volume hydraulic pump and wheel motors ; hydraulic transmission power approx. 40 KW/55 HP; steering via two foot pedals controls, (optionally interchangeable to hand lever controls), ground -transport speed up to 6 km/h ❖ <u>Auger Drive:</u> dedicated hydraulic gear pump (to allow simultaneous operation of the two tracks and auger drive); operation and steering via directional valve and one hydraulic pilot control joystick (6 functions), in-water propulsion speed up to 6 km/h forward and 3 km/h reverse ❖ <u>Crane operation:</u> dedicated gear pump; operation via directional valve and two hydraulic pilot control joysticks ❖ <u>General:</u> All functions are bi-directional, variable and speed adjustable, system includes filtration, tank breather, hydraulic gauge, pressure relief valves, hydraulic power transmission up to 40 KW/55 HP	
Cock Pit:	❖ Comfortable driver seat with left and right armrests as well as back and headrest ❖ Conveniently and comfortably arranged operational control levers for easy operator's reach as well as monitoring instruments in clear view to the operator's position ❖ Weather protection canvass enclosure	
Working units:	❖ T-Cutter bar, Clearing & collecting – rake (also available with fine screen) Excavating bucket, Centrifugal pump with HARDON inner casing, 6" suction x 6" discharge, Tree cutter, Tree saw (check with factory), Mowing bucket	
Accessories:	❖ Electrical bilge pump, Two 12 DC Volt power sockets, 3-point linkage at front, Battery switch, Diesel fuel-water separator, Engine oil-change withdrawal pump	



Schröer Environment and Water Technology GmbH & Co. KG Im Industriepark 17, 49733 Haren, GERMANY
 Telephone: +(49)-5932-7398949 Fax: + (49)-5932-739894 info@senwatec.de www.senwatec.de
 In North-Central and South America, USA* Telephone: + (352) 503-9363 * Mobile Telephone: (954) 826-7355
info@senwatec.com www.senwatec.com

❖ **Builders of Front Line Open Water Management Boats, Vehicles and Equipment**

EXHIBIT G

Auszug der Teichräumliste 2010.

<u>Auftraggeber</u>	<u>Auftrag</u>	<u>Ausführender</u>
Markt Neubrunn	Teich Räumen und landw. Verwerten	Funck
Gemeinde Breitenbach / Herzberg	Teich Räumen und landw. verwerten	Funck
Gemeinde Bad Griesbach	Teich umpumpen	Funck
AZV Untereisenheim	Klärteich räumen	Funck
Stadtwerke Bad Sooden Allendorf	Teich Räumen und landw. Verwerten	Funck
Gemeinde Philippsthal	Naturteich Unter Wasser Räumen und Verwerten	Funck
Gemeinde Frielendorf	Teich Räumen und Verwerten	Funck
Gemeinde Biebergemünd	Schlamm Rühren und Pumpen	Funck
AWP	Teich Räumen	Funck
VG Thalfang	Teich rühren	Funck
Stadt Zierenberg	Teich Räumen und landw. verwerten	Funck
Marktverwaltung Untergriesbach	Teich räumen und landw. verwerten	Herrlich
Gemeinde Ehringshausen	Teich räumen und landw. verwerten	Herrlich
VG Langenneufnach	Teich räumen + landw. verwerten	Herrlich
Markt Hohenwart	Teich räumen + landw. verwerten	Herrlich
AV Wertach-Ost	Teich umpumpen	Herrlich online
Kottermair Ing.	Teich räumen	Herrlich online
Kottermair Ing.	Teich räumen + landw. verwerten	Herrlich online

EXHIBIT H



Google Earth



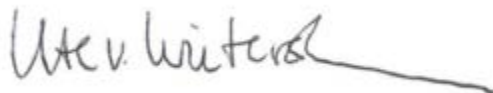
Translation Declaration

I, Ute von Wietersheim do hereby declare as follows:

1. I certify that the attached translation from English to German is an accurate representation of the documents received by this office. The document is designated as: 05 09 2024—Declaration Translation.

2. Ute von Wietersheim, Translator, attests to the following: “To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents.”

3. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under the laws of the United States, including 18 U.S.C. § 1001.

Signature: 

Name: Ute von Wietersheim

Title: Translator

I, Reinhard Speerschneider, hereby declare the following based on my personal knowledge:

I. INTRODUCTION

1. I am over the age of 18. My current residence is in Rinnthal, Germany.
2. I was the president of the company UD Umwelt-Dienste GmbH (“UD Umwelt-Dienste”) from 2002 to 2017.
3. While I was the president of UD Umwelt-Dienste, I oversaw the use of the SenwaTec Amphi-King vehicle (“Amphi-King”) in sewage slurry lagoons to pump the sewage slurry from the sewage slurry lagoons.
4. I have no financial interest in the outcome of this proceeding.

II. BACKGROUND

5. In my experience, prior to 2013, the purpose of UD Umwelt-Dienste’s marketing materials was to educate the public and generate public interest in their products and services. Prior to 2013, it was UD Umwelt-Dienste’s standard business practice to make its marketing materials publicly available, e.g., by distributing them to customers and potential customers and also making them accessible on their website. Prior to 2013, if customers or potential customers sought information such as brochures, marketing videos, treatment plant demonstrations and marketing materials about the UD Umwelt-Dienste’s services relating to the Amphi-King, this information would be provided at no cost and without any confidentiality restrictions. For example, prior to 2013, customers of UD Umwelt-Dienste often described the problems they had with their facilities. UD Umwelt-Dienste would discuss these problems with the customers and provide them with USB drive with a marketing video, of which screenshots are included in Exhibit A.

6. In addition, UD Umwelt-Dienste created its own marketing materials in which the lagoon treatment services (pumping and removal) was presented. *See e.g., Exhibit A.* Exhibit A contains screenshots from a marketing video for the lagoon agitation and pumping services offered by UD Umwelt-Dienste using the Amphi-King. It was created and publicly distributed prior to 2013. I am personally familiar with this marketing video.

III. AUTHENTICITY AND PUBLIC ACCESSIBILITY OF EXHIBIT A

7. Exhibit A is a true and accurate copy of a series of screenshots from a marketing video released by UD Umwelt-Dienste in 2012. The screenshots shown in Exhibit A truthfully and accurately portray the marketing video of UD Umwelt-Dienste. It shows Eckhard Funck, a former employee of UD Umwelt-Dienste, operating the Amphi-King in a sewage slurry lagoon and pumping sewage slurry in 2012.

8. UD Umwelt-Dienste created the marketing video shown in Exhibit A before May 7, 2012. I know that the video shown in Exhibit A was created before May 7, 2012, because this marketing video was shown at the IFAT Trade Show in Munich between May 7 and 11, 2012. IFAT is a large trade show for the water, sewage, waste and the feedstock industry. I would estimate that around 100,000 people visited the IFAT Trade Show in 2012.

9. I personally saw this video playing on the TV screens at the booth that UD Umwelt-Dienste had at the IFAT Trade Show in May 2012. Hundreds of visitors walked past the booth and saw the video that was playing. There were no confidentiality restrictions placed on any trade show attendees watching the video and they were free to take notes, pictures, or videos of the video of Exhibit A. A copy of the marketing video, of which the screenshots are included in Exhibit A, may be found under the following link:

<https://www.youtube.com/watch?v=ecnlfMf7CH4>. The video shown under this link is the same video that was publicly shown at the IFAT Trade Show in May 2012.

10. After the IFAT Trade Show and before August 2013, USB drives with a copy of the video were sent to many interested customers of UD Umwelt-Dienste, including, without limitation or restriction, EWE Wasser GmbH. There were no confidentiality restrictions for those who saw the video at the IFAT Trade Show or who were later sent a copy of the video.

IV. THE AMPHI-KING AND AUTHENTICITY AND PUBLIC ACCESSIBILITY OF EXHIBIT B

11. I am personally familiar with the Amphi-King vehicle and its features. As shown by the screen shots of the UD Umwelt marketing video of Exhibit A, UD Umwelt-Dienste used the Amphi-King on numerous occasions in 2013 and earlier. Exhibit B truthfully and accurately portrays and describes the Amphi-King amphibious vehicle that UD Umwelt-Dienste maneuvered into sewage slurry lagoons, used to agitate sewage slurry lagoons, and used to pump out sewage slurry from lagoons to be used as fertilizer on farm fields, as depicted and described in the marketing video, of which screen shots are attached in Exhibit A.

12. I personally observed the Amphi-King. While observing the Amphi-King, I personally saw that the pump included a housing with a bottom fluid inlet and an impeller connected to a drive shaft for driving the rotation of the impeller. I also personally observed that the Amphi-King, included six air filled tires. These features are also shown in the marketing video, of which screenshots are included as Exhibit A.

13. I also personally observed that the pump can operate with a variable flow rate. UD Umwelt-Dienste used the variable flow rate pump to agitate the sewage slurry in the lagoon and pump the sewage slurry from the lagoon to be applied to agricultural fields. I personally

observed UD Umwelt-Dienste spraying the sewage slurry from the lagoon through the air and back onto the lagoon to disrupt the surface crust of the lagoon.

V. CERTIFICATION

14. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury under the law of the United States of America that the foregoing is true and correct.

Signature: __[h/w]_____

Name: Reinhard Speerschneider_____

Date: 04.24.2024_____

Ich, Reinhard Speerschneider, erkläre hiermit nach meinem persönlichen Wissens Folgendes:

I. EINLEITUNG

1. Ich bin über 18 Jahre alt. Mein derzeitiger Wohnsitz befindet sich in Rinnthal, Deutschland.

2. Von 2002 bis 2017 war ich Geschäftsführer der UD Umwelt-Dienste GmbH („UD Umwelt-Dienste“).

3. Während meiner Amtszeit als Vorsitzender von UD Umwelt-Dienste war ich für den Einsatz des SenwaTec Amphi-King-Fahrzeugs („Amphi-King“) in Klärteichen zum Abpumpen des Klärschlammes aus Klärteichen verantwortlich.

4. Ich habe kein finanzielles Interesse am Ausgang dieses Verfahrens

II. HINTERGRUND

5. Nach meiner Erfahrung bestand der Zweck der Marketingmaterialien von UD Umwelt-Dienste vor 2013 darin, die Öffentlichkeit aufzuklären und das öffentliche Interesse an ihren Produkten und Dienstleistungen zu wecken. Vor 2013 war es bei UD Umwelt-Dienste gängige Geschäftspraxis, Marketingmaterialien öffentlich zugänglich zu machen, beispielsweise indem diese an Kunden und potenzielle Kunden verteilt und auch auf der Website zugänglich gemacht wurden. Wenn Kunden oder potenzielle Kunden vor dem Jahr 2013 Informationen wie Broschüren, Marketingvideos, Kläranlagenvorführungen oder Marketingmaterialien über die Dienstleistungen

der UD Umwelt-Dienste rund um den Amphi-King anforderten, wurden ihnen diese Informationen kostenlos und ohne jegliche Vertraulichkeitsbeschränkungen zur Verfügung gestellt. So kam es vor 2013 beispielsweise immer wieder vor, dass Kunden der UD Umwelt-Dienste Probleme mit ihren Anlagen schilderten. UD Umwelt-Dienste besprach diese Probleme mit den Kunden und stellt ihnen einen USB-Stick mit einem Marketingvideo zur Verfügung, von dem Screenshots in Anlage A zu finden sind.

6. Darüber hinaus erstellte UD Umwelt-Dienste eigene Marketingmaterialien, in denen die Dienstleistungen zur Lagunenbehandlung (Abpumpen und Entfernen) vorgestellt wurden. *Siehe beispielsweise Anlage A.* Anlage A enthält Screenshots aus einem Marketingvideo für die von UD Umwelt-Dienste angebotenen Klärteich-Rühr- und Pumpdienste unter Verwendung des Amphi-King. Es wurde vor 2013 erstellt und öffentlich verbreitet. Ich kenne dieses Marketingvideo persönlich.

III. ECHTHEIT UND ÖFFENTLICHE ZUGÄNGLICHKEIT VON ANLAGE A

7. Bei Anlage A handelt es sich um eine wahrheitsgetreue und echte Kopie einer Reihe von Screenshots aus einem Marketingvideo, das 2012 von UD Umwelt-Dienste veröffentlicht wurde. Die in Anlage A gezeigten Screenshots stellen das Marketingvideo von UD Umwelt-Dienste wahrheitsgetreu und korrekt dar. Es zeigt Eckhard Funck, einen ehemaligen

Mitarbeiter der UD Umwelt-Dienste, bei der Bedienung des Amphi-King in einem Klärteich und beim Abpumpen von Klärschlamm im Jahr 2012.

8. UD Umwelt-Dienste hat das in Anlage A gezeigte Marketingvideo vor dem 7. Mai 2012 erstellt. Ich bin mir sicher, dass das in Anlage A gezeigte Video vor dem 7. Mai 2012 erstellt wurde, da dieses Marketingvideo vom 7. bis 11. Mai 2012 auf der Fachmesse IFAT in München gezeigt wurde. Die IFAT ist eine große Fachmesse für die Wasser-, Abwasser-, Abfall- und Rohstoffindustrie. Ich schätze, dass rund 100.000 Menschen die IFAT-Messe im Jahr 2012 besucht haben.

9. Ich persönlich habe dieses Video auf den Fernschirmen am Stand von UD Umwelt-Dienste auf der IFAT-Messe im Mai 2012 gesehen. Hunderte von Besuchern gingen am Stand vorbei und sahen das laufende Video. Für die Messebesucher, die das Video ansahen, gab es keine Vertraulichkeitsbeschränkungen, und sie durften sich nach Belieben Notizen, Bilder oder Videos von dem Video in Anlage A machen. Eine Kopie des Marketingvideos, dessen Screenshots in Anlage A enthalten sind, finden Sie unter dem folgenden Link: <https://www.youtube.com/watch?v=ecnlfMf7CH4> . Bei dem unter diesem Link gezeigten Video handelt es sich um dasselbe Video, das auf der IFAT-Messe im Mai 2012 öffentlich gezeigt wurde.

10. Im Anschluss an die IFAT-Messe und noch vor August 2013 wurden USB-Sticks mit einer Kopie des Videos an viele interessierte Kunden von UD Umwelt-Dienste verschickt, unter anderem und ohne Einschränkung an

die EWE Wasser GmbH. Es keine Vertraulichkeitsbeschränkungen für diejenigen, die das Video auf der IFAT-Messe gesehen haben oder denen später eine Kopie des Videos zugeschickt wurde.

IV. DER AMPHI-KING UND DIE ECHTHEIT UND ÖFFENTLICHE ZUGÄNGLICHKEIT VON ANLAGE B

11. Ich bin persönlich mit dem Amphi-King-Fahrzeug und seinen Eigenschaften vertraut. Wie aus den Screenshots des Marketingvideos von UD Umwelt in Anlage A hervorgeht, hat UD Umwelt-Dienste den Amphi-King 2013 und auch davor mehrfach eingesetzt. Anlage B stellt das Amphibienfahrzeug Amphi-King wahrheitsgetreu und genau dar und beschreibt wie UD Umwelt-Dienste es in Klärteiche manövriert, um Klärteiche umzurühren und Klärschlamm aus Klärteichen zu pumpen, der dann als Dünger auf landwirtschaftlichen Feldern verwendet wird, wie im Marketingvideo, dessen Screenshots in Anlage A beigelegt sind, dargestellt und beschrieben.

12. Ich habe das Amphi-King-Fahrzeug persönlich beobachtet. Beim Beobachten des Amphi-King-Fahrzeugs habe ich persönlich gesehen, dass die Pumpe ein Gehäuse mit einem unteren Flüssigkeitseinlass und einem Laufrad umfasst, das mit einer Antriebswelle verbunden ist, um das Laufrad in Drehung zu versetzen. Mir ist auch persönlich aufgefallen, dass das Amphi-King-Fahrzeug sechs luftgefüllte Reifen hat. Diese Funktionen werden auch im Marketingvideo gezeigt, dessen Screenshots als Anlage A beigelegt sind.

13. Ich habe auch persönlich beobachtet, dass die Pumpe mit einer variablen Durchflussrate arbeiten kann. UD Umwelt-Dienste nutzte die Pumpe mit der variablen Durchflussrate, um den Klärschlamm in dem Klärteich umzurühren und den Klärschlamm aus den Klärteich zu pumpen, um ihn auf landwirtschaftliche Felder auszubringen. Ich habe persönlich beobachtet, wie UD Umwelt-Dienste den Klärschlamm vom Klärteich in die Luft und zurück auf den Klärteich sprühte, um die Oberflächenkruste des Klärteichs aufzubrechen.

V. BESCHEINIGUNG

14. Hiermit bestätige ich, dass alle hierin gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen und dass alle Angaben, die ich nach bestem Wissen und Gewissen gemacht habe, der Wahrheit entsprechen und dass diese Angaben in Kenntnis der Tatsache gemacht wurden, dass vorsätzliche Falschaussagen und dergleichen gemäß 18 U.S.C. § 1001 mit Geld- oder Freiheitsstrafe oder beidem geahndet werden. Ich versichere unter Androhung einer Strafe wegen Meineids nach dem Recht der Vereinigten Staaten von Amerika, dass das Vorstehende wahr und richtig ist.

Unterschrift: Reinhard Speerschneider

Name: Reinhard Speerschneider

Datum: 24. 04. 2024

EXHIBIT A





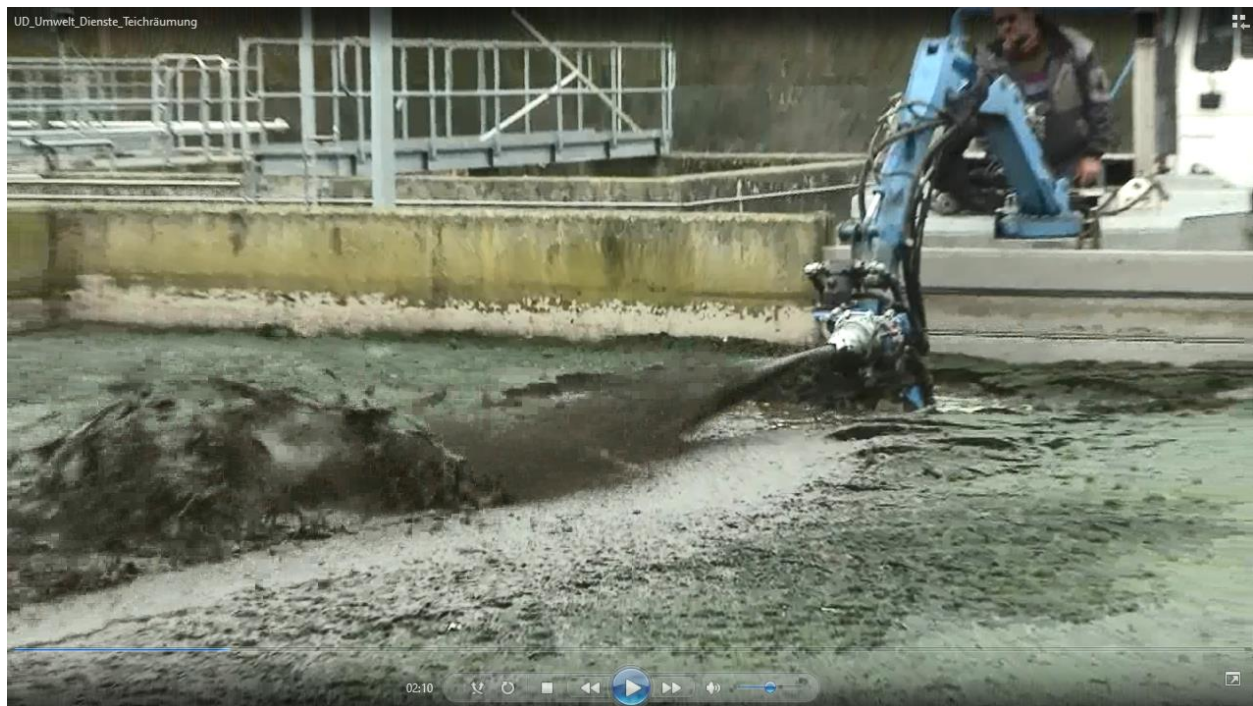






EXHIBIT B



40 YEARS OF EXPERIENCE IN THE DEVELOPMENT OF:

- *DITCH CLEANER AND SLOPE MOWERS*
- *MOWING AND CLEARING BOATS*
- *WEED HARVESTERS*
- *AMPHIBIOUS VEHICLES*
- *CUTTER SUCTION AND EXCAVATING DREDGES*

SCHRÖER ENVIRONMENT AND WATER TECHNOLOGY

Light Amphibious Boat/Vehicle

"Amphi-King®" SWT-AB380

- ❖ Light and strong aluminum construction, approximately 2480 kg (5,500 lbs.), without attachments
- ❖ 6-wheel drive or track drive system (track drives are patented system)
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- ❖ Heavy duty Diesel engine certified to the latest standards of Tier IV emission and fuel consumption
- ❖ Optimal configuration of power requirements and hydraulic unit (less operating costs)
- ❖ Low ground pressure and good clearance on terrain, marches and swamps during on-land drives
- ❖ Shallow vessel draft with, low center of gravity for safe on-water maneuvering
- ❖ High working range and wide swing radius of the hydraulic crane arm, ready for many attachments
- ❖ Operating controls conveniently placed and adjustable to suite operator's seat position
- ❖ Vehicle construction & safety configuration according to European & International standards



A compact muscular vehicle with tracks

With a powerful centrifugal pump and 8" suction- and 6" discharge ports, hydraulically driven, delivering 40 kW of pumping power



6-Wheel driven unit with stabilizer pontoons



- Ergonomic arrangement of the operating and monitoring elements



-A compact transport package on the tilt deck trailer

Equipment Attachment, Working Tools, Features:



- Optional 6-wheel drive version shown, for reduced ground pressure
- Powerful wheel / track drives for banks & slopes of up to 30°
- Stable forward crane with slew ring for 270° swing (135° per side)



- Hydraulic auger propulsion, depth adjustable, c/w:
- Swing steering & power tilt for easy maintenance-
 - Auger counter cutter for no-wrap weed clearing

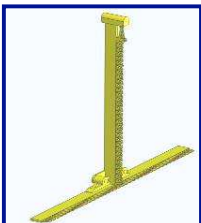
Tilt-deck trailer c/w low deck, on-off ramp & electro-hydraulic power pack



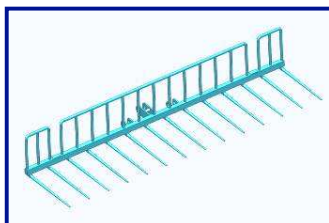
Capacities and Dimenions:

- GVRW : 3500 kg (7,700 lbs.) Load capacity: 2570 kg (5,660 lbs.)
Box length: 4,48 m (14'-6") Side height: 20 cm (8")
Deck height: 68 cm (27") Length overall : 6,21 (20'-5")
Width overall: 2,44 m (8'-0")
Finish: Aluminum and hot-dip galvanized.
Sides are removable to full deck width of 2,44 m (8'-0")

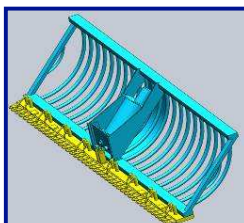
Available working tools and attachment units:



T-Shaped Cutter-Bar



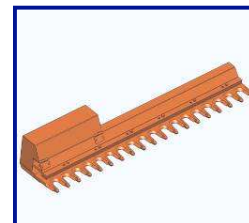
Clearing & Collecting Rake



Mowing Bucket



Excavating Bucket



Tree Cutter



Equipped with suction auger for sludge



Suction an pumping of swimming algae and weeds

Specifications

	<i>Amphi-King® SWT-AB380 (with 6-wheel-drive)</i>	<i>Amphi-King® SWT-AB380-RF (with track-drives)</i>
<u>Dimensions,</u> Compact: Hull: Shipping: Material: Draft: Freeboard: Weights:	L x W x H: 3,80 m x 2,35 m x 1,35 m (12'-5" x 6'-7" x 4'-5") L x W x H: 3,80 m x 1,25 m x 1,00 m (12'-5" x 4'-2" x 3'-4") L x W x H: 4,30 m x 2,35 m x 1,50 m (14'-2" x 6'-7" x 4'-11") Robust marine aluminum construction Average @ 55 cm (22") below hull, Approximately 45 cm (18") Approximately 2350 kg (5,200 lbs.), without attachments	L x W x H: 3,80 m x 2,35 m x 1,35 m (12'-5" x 7'-9" x 4'-5") L x W x H: 3,80 m x 1,25 m x 1,00 m (12'-5" x 4'-2" x 3'-4") L x W x H: 4,30 m x 2,35 m x 1,50 m (14'-2" x 7'-9" x 4'-11") Robust marine aluminum construction Average @ 55 cm (22") below hull, with Approximately 45 cm (18") Approximately 2480 kg (5,500 lbs.), without attachments
Drive Wheels and Tracks:	6-wheel vehicle, tires ø 92 cm (36") x 32 cm (12.6") wide, Alternate tire width: 42 cm (16.5")	Vehicle tracks (2) @ 50 cm (20") width driven by four (4) powerful high torque hydraulic motors
Crane Capacity:	❖ Length of 2,40 m (7'-10"), working depth up to 1,20 m (47") below water level, load height up to 2,00 m (6'-7") Slewing ring swing range 270°. Lift capacity: boom stretched out: 320 kg; boom closest to vehicle: 550 kg	
Engine:	❖ Powerful Diesel engine with 55 KW/74 HP @ 2200 RPM, temperature & oil pressure monitoring system	
Hydraulics System:	❖ <u>Track / Wheel drive mechanism:</u> Transmission over variable volume hydraulic pump and wheel motors ; hydraulic transmission power approx. 40 KW/55 HP; steering via two foot pedals controls, (optionally interchangeable to hand lever controls), ground -transport speed up to 6 km/h ❖ <u>Auger Drive:</u> dedicated hydraulic gear pump (to allow simultaneous operation of the two tracks and auger drive); operation and steering via directional valve and one hydraulic pilot control joystick (6 functions), in-water propulsion speed up to 6 km/h forward and 3 km/h reverse ❖ <u>Crane operation:</u> dedicated gear pump; operation via directional valve and two hydraulic pilot control joysticks ❖ <u>General:</u> All functions are bi-directional, variable and speed adjustable, system includes filtration, tank breather, hydraulic gauge, pressure relief valves, hydraulic power transmission up to 40 KW/55 HP	
Cock Pit:	❖ Comfortable driver seat with left and right armrests as well as back and headrest ❖ Conveniently and comfortably arranged operational control levers for easy operator's reach as well as monitoring instruments in clear view to the operator's position ❖ Weather protection canvass enclosure	
Working units:	❖ T-Cutter bar, Clearing & collecting – rake (also available with fine screen) Excavating bucket, Centrifugal pump with HARDOX inner casing, 6" suction x 6" discharge, Tree cutter, Tree saw (check with factory), Mowing bucket	
Accessories:	❖ Electrical bilge pump, Two 12 DC Volt power sockets, 3-point linkage at front, Battery switch, Diesel fuel-water separator, Engine oil-change withdrawal pump	



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