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CA 2416690 A1 2004/07/20

(21) 2 416 690

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2003/01/20

(41) Mise à la disp. pub./Open to Public Insp.: 2004/07/20

(51) Cl.Int.^{7}/Int.Cl.^{7} C02F 3/28, C02F 11/04

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(54) Titre : PROCEDE POUR ELIMINER DES ELEMENTS NUTRITIFS DE FUMIERS COMPOSTES OU D'AUTRES DECHETS ORGANIQUES OU POUR LES RECUPERER

(54) Title: PROCESS FOR REMOVAL AND RECOVERY OF NUTRIENTS FROM DIGESTED MANURE OR OTHER ORGANIC WASTES

(57) Abrégé/Abstract:
A process for removal and recovery of nutrients from digested manure or other organic wastes. A first step involves separating waste from an anaerobic digester into digested liquids and digested solids. A second step involves precipitating solids from the digested liquids. A third step involves stripping ammonia from the digested liquids. A fourth step involves injecting an exhaust stream of carbon dioxide drawn from the anaerobic digester into the digested liquids to reduce the pH and raise the temperature of the digested liquid. A fifth step involves recycling the digested liquids back to the anaerobic digester for use in diluting in coming solid wastes. A sixth step involves passing the excess ammonia stripped from the digested liquid through the digested solids to recover nitrogen through aborption with the resultant digested solids being usable as a biofertilizer with a high nitrogen content. A seventh step involves capturing the biogas for use in power generation.

ABSTRACT OF THE DISCLOSURE

A process for removal and recovery of nutrients from digested manure or other organic wastes. A first step involves separating waste from an anaerobic digester into digested liquids and digested solids. A second step involves precipitating solids from the digested liquids. A third step involves stripping ammonia from the digested liquids. A fourth step involves injecting an exhaust stream of carbon dioxide drawn from the anaerobic digester into the digested liquids to reduce the pH and raise the temperature of the digested liquid. A fifth step involves recycling the digested liquids back to the anaerobic digester for use in diluting in coming solid wastes. A sixth step involves passing the excess ammonia stripped from the digested liquid through the digested solids to recover nitrogen through aborption with the resultant digested solids being usable as a biofertilizer with a high nitrogen content. A seventh step involves capturing the biogas for use in power generation.

TITLE OF THE INVENTION:

Process for removal and recovery of nutrients from digested manure or other organic wastes

FIELD OF THE INVENTION

The present invention relates to a process for removal and recovery of nutrients from digested manure or other organic wastes

BACKGROUND OF THE INVENTION

Anerobic digestion of manure and other organic wastes inherently produce byproducts which have a negative environmental impact. These byproducts include solids with a high ammonia content and greenhouse gas emissions.

SUMMARY OF THE INVENTION

What is required is an integrated process for removal and recovery of nutrients from digested manure or other organic wastes that will reduce, if not eliminate, such negative environmental impact.

According to the present invention there is provided a process for removal and recovery of nutrients from digested manure or other organic wastes. A first step involves separating waste from an anaerobic digester into digested liquids and digested solids. A second step involves precipitating solids from the digested liquids. A third step involves stripping ammonia from the digested liquids. A fourth step involves injecting an exhaust stream of carbon dioxide drawn from the anaerobic digester into the digested liquids to reduce the pH and raise the temperature of the digested liquid. A fifth step involves recycling the digested liquids back to the anaerobic digester for use in diluting in coming solid wastes. A sixth step involves passing the excess ammonia stripped from the digested liquid

through the digested solids to recover nitrogen through aborption with the resultant digested solids being usable as a biofertilizer with a high nitrogen content. A seventh step involves capturing the biogas for use in power generation.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to in any way limit the scope of the invention to the particular embodiment or embodiments shown, wherein:

FIGURE 1 is a block diagram of a process for removal and recovery of nutrients from digested manure or other organic wastes in accordance with the teachings of the present invention.

FIGURE 2 is a flow diagram of a process for removal and recovery of nutrients from digested manure or other organic wastes in accordance with the teachings of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred process for removal and recovery of nutrients from digested manure or other organic wastes will now be described with reference to **FIGURES 1** and **2**.

The process is for removal and recovery of nutrients (N, P) from digested manure or other organic wastes. It integrates lime precipitation, air stripping, bio-absorption using aggregated solids and pH adjustment using exhaust gas from co-generation system (Figure 1). In the process, the centrifuged digested liquid after solid/liquid separation goes into the calcium phosphate precipitation reactor with addition of lime combined with wood ash. The generated

calcium phosphate solids are separated in a settling tank. The settled materials have higher nutrient value due to the wood ash addition. Then, the liquid goes through an air-stripping tower to strip out the excess ammonia. This stripping process allows removing high NN4 content, up to 3000 ppm from the digested manure. This continuous process allow remove both N and P after pH adjustment. After the air-stripping tower, the pH of the liquid stream is reduced to below 7 with exhaust gas containing CO2 from the co-generation system. This injection of exhaust gas will increase temperature of the liquid, which can be recycled back to the hopper. The ammonia-enriched gas will be pumped into a column filled with aggregated-centrifuged solid. Nitrogen will be recovered through absorption process. The resulted solids contain high nitrogen content.

This nutrient recovery system can be integrated a comprehensive manure utilization system(IMUS), which consists of seven major components: manure (organic materials)handling, biogas production, biogas utilization, liquid/solid separation, nutrient recovery system, bio-based fertilizer production and an integrating system (Figure 2). Fresh manure or organic materials enters dump hopper. The dump hopper is equipped to adjust temperature and solid/liquid ratio of manure to a predetermined level. Biogas production is achieved through anaerobic digestion. Temperature in the anaerobic digesters is maintained at 55 to 60°C, which is to create an optimal growth temperature for a consortium of thermophilic bacteria. This condition will shorten the hydraulic retention time, destroy over 99% of pathogens present in raw manure and maximize biogas production. Biogas utilization includes a co-generation unit, which is connected to the grid, and a heat exchanger system,which allows delivery of waste heat produced by the

co-generation unit to digesters, the hopper and Fertilizer production system. After the anaerobic digestion that produces biogas, the remaining material is transferred to a centrifuge system for liquid/solid separation. The liquid is then treated in the nutrient recovery system through physical and chemical processes to recover nitrogen and phosphate and produce reusable water. The solids are processed through aggregation process combined with a nutrient enrichment process, if required, to produce solid bio-based fertilizer with balanced nutrients. The bio-based fertilizer will be produced in different forms and moisture contents depending on the end uses and transportation requirements. The rate of nutrient release from the bio-based fertilizers is controlled by the aggregate size and density. The last component is to integrate all these processes and optimize each component and makes anaerobic digestion and nutrient recovery from manure or other organic wastes an economically viable operation. This integrated process will mitigate greenhouse gas emissions and reduce other negative environmental impacts associated with manure and organic waste management.

In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

It will be apparent to one skilled in the art that modifications may be made to the illustrated embodiment without departing from the spirit and scope of the invention

as hereinafter defined in the Claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A process for removal and recovery of nutrients from digested manure or other organic wastes, comprising the steps of:

separating waste from an anaerobic digester into digested liquids, digested solids and biogas;

precipitating solids from the digested liquids;

stripping ammonia from the digested liquids;

injecting an exhaust stream of carbon dioxide drawn from the anaerobic digester into the digested liquids to reduce the pH and raise the temperature of the digested liquid;

recycling the digested liquids back to the anaerobic digester for use in diluting in coming solid wastes;

passing the excess ammonia stripped from the digested liquid through aborption with the resultant solids being usable as a biofertilizer with a high nitrogen content; and

capturing the biogas for use in power generation.

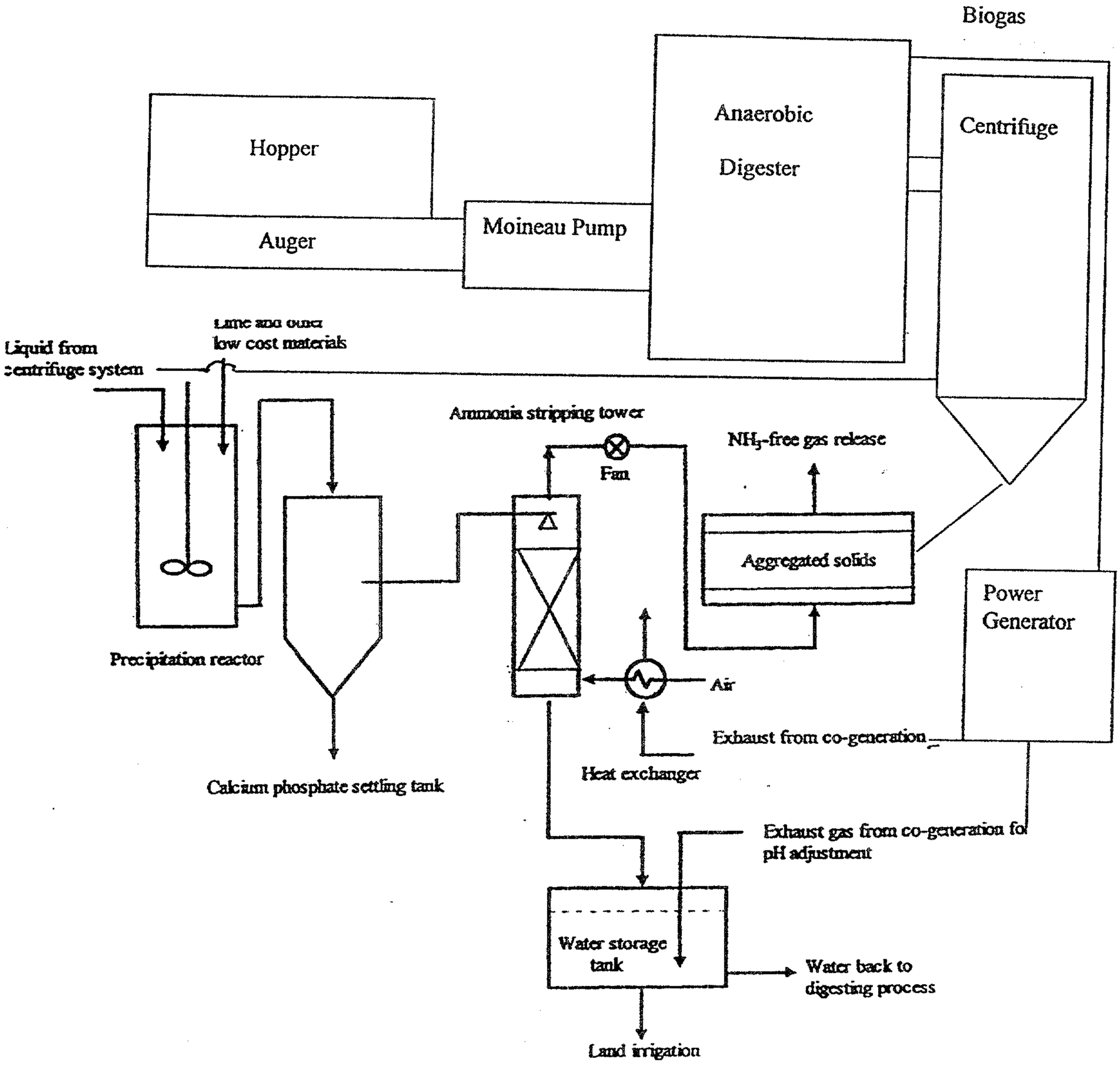
Biogas
Hopper
Auger
Moineau Pump
Anaerobic
Digester
Centrifuge
Liquid from
centrifuge system
Lime and other
low cost materials
Ammonia stripping tower
Fan
NH3-free gas release
Aggregated solids
Power
Generator
Precipitation reactor
Air
Exhaust from co-generation
Heat exchanger
Exhaust gas from co-generation for
pH adjustment
Water storage
tank
Water back to
digesting process
Calcium phosphate settling tank
Land irrigation

FIG. 1

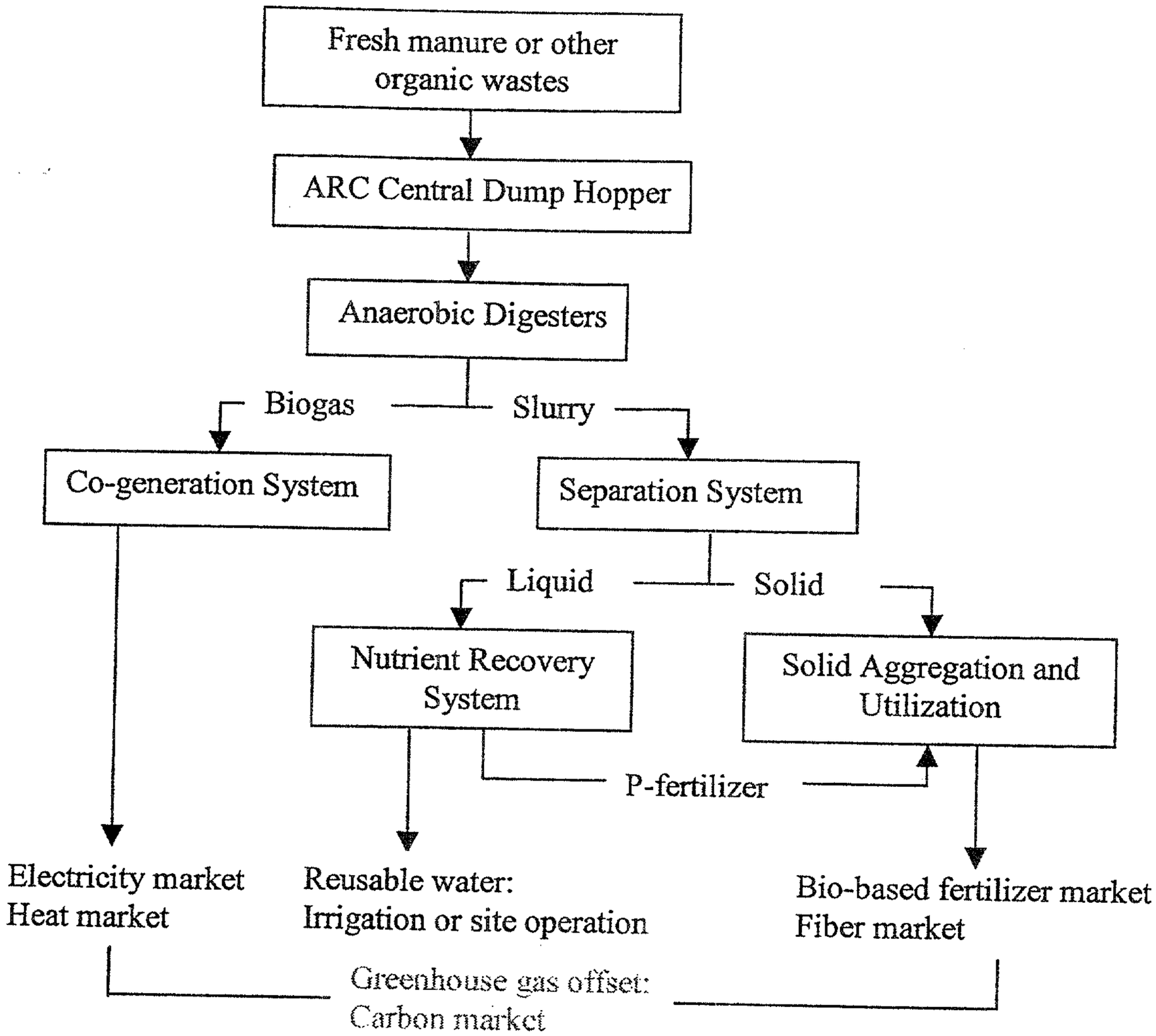
Fresh manure or other organic wastes
ARC Central Dump Hopper
Anaerobic Digesters
Biogas
Slurry
Co-generation System
Separation System
Liquid
Solid
Nutrient Recovery System
Solid Aggregation and Utilization
P-fertilizer
Electricity market
Heat market
Reusable water:
Irrigation or site operation
Bio-based fertilizer market
Fiber market
Greenhouse gas offset:
Carbon market

FIG. 2