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空气密闭循环式污泥干化设备

CLOSE LOOP AIR CIRCULATION SLUDGE DRYER

无锡康灿环保科技有限公司
Wuxi Kinsan Environmental Protection Technology Co., Ltd.
地址：江苏省宜兴市高塍镇中心路 159,161 号
电话：0510-87890787 传真：0510-87890787
邮箱：leochien@kinsan.cn 邮编：214214

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技术原理 Technical Principle

空气密闭循环式污泥干化设备（CLACSD）是一种利用产生的干空气在系统内循环流动，同时提供热能间接加热污泥，結合热传、质传与汙泥攪動以加速对污泥干化效率的处理技术，可把经板框压滤机、带式压滤机、叠螺脱水机和离心脱水机的含水率从80%~85%降为含水率10%以下的干化泥块。该技术能够将污泥体积缩减 4 分之 1，只需要消耗电能，不需要其它辅助能源，能耗是常规电热或直热式干化设备的 1/3。但若客户有废蒸汽或 70℃以上废热水，可利用废热的热能补助，大幅降低污泥干化的能耗。系统对外界的湿度与温度也没有特殊要求，整个系统能持续保持高效率的运行。

传统污泥热干化系统能耗大的原因是系统热量的 90% 转化成排风热损失（水蒸汽潜热及热空气显热），为了降低能耗，无锡康灿环保科技股份有限公司自创的 CLACSD 密闭循环式除湿污泥干化技术，是一种结合热泵节能和干风除湿技术应用于污泥干化系统。污泥干燥过程中，以干燥空气为介质，将污泥水分转换到干燥热风中，再利用除湿热泵对湿空气进行脱湿降温，热泵吸收脱湿降温的热量后，将此热量用于提升空气温度；循环干空气再回到污泥干燥箱继续将污泥中的水分扩散至密闭循环空气中。

本系统在除湿干化过程中，没有任何废气排放，同时回收水蒸汽的潜热与显热，回收的热量再回用于补充污泥干燥加热所需热量，故能大幅降低污泥干化的能耗。

There is not only generated dry air in the Close Loop Air Circulation Sludge Dryer (CLACSD) in order to maintain dryness of circulated air in the system. But also it is providing indirect heat to enhance treatment efficiency. Combined heat and mass physical transfer reactions and sludge stirring effect in CLACSD system will speed up sludge drying procedure. No matter sludge generated from filter press, belt filter, screw press or centrifugal dehydrator with 80%~85% water content could be reduced to less than 10% water content of treated dry sludge. The treated sludge volume can be one quarter of raw wet sludge. The heat source of CLACSD system is generated by electricity only. The auxiliary energy is not required normally. The energy consumption rate is one third of conventional electric or directly heating drying equipment. If the customer can supply enough extra waste steam or at least 70℃ hot water as heat supply source, the energy consumption rate will be significantly reduced. The system can be operated efficiently under normal the humidity and temperature of environment.

The heat loss of traditional sludge drying system is around 90% as steam latent and air sensible heat of exhaust to environment. The unique technology of CLACSD system is combined high efficiency heat pump indirect heating design, dry-air dehumidifying technology and sludge stirring effect . During drying process, dry air plays the role of a carrying medium of humidity which comes from sludge. The near saturated humidity of worm air is passed through the dehumidifier which absorbs latent heat and sensible heat. Absorbed heat is transferred to heat pump by cold water. The heat pump is released heat by warm water which is heat source for air heater. The warm air is heated up after passing through air heater and it goes back to dryer in order to continuously absorb the moisture from sludge. It is a close loop air circulation system.

There is no exhaust released to environment during sludge drying process. In the mean time, the latent heat and sensible heat of humidity is recovered and feed back as supplement the heat to the system. it can significantly reduce the energy consumption of sludge drying process.

工艺流程 System Process

污泥流程 Sludge Process

含水率 70 ~ 85% 污泥由上方进入间接加热干燥箱后，干燥箱内含数层干燥层，每层设刮臂，污泥就一层一层的往下层落料直到出料口，出料口可为吨袋或污泥储料仓；在落料的过程，污泥经过翻搅、水份扩散到干空气的质传与热传等作用，以达到快速干燥的目的。

70 ~ 85% water content sludge is fed from the top of the indirect heating dryer. There are several layers of dryer. The function of scraping arms of each layer is moving sludge to next layer until dryer discharge port at lowest layer. There could be a storage bag for temporary storage at discharge port or it is delivered to treated sludge storage tank. During sludge moving procedure, sludge is stirring by scraping arms. It is dramatically increased sludge drying efficiency by combined heat，mass transfer and stirring physical reactions.

空气循环流程 Air Circulation Process

干空气从干燥箱底部进入，一层一层从下往上流动直到干燥箱顶端的出风口，干空气通过各层的污泥表面时，将污泥水分转换成空气中的湿度，污泥就快速的干化。湿空气从出风口经到风机增压后到冷凝器，在冷凝器中降温脱湿，湿空气离开冷凝器后成干空气，因空气温度降低使露点温度降低，水分子产生滴状凝结效应而形成水滴从冷凝器冷凝器底部排到冷凝水槽。干空气可直接回到干燥箱或经加热器中升温再回到干燥箱底部。空气一直循环不外排，不需考虑臭味与废气处理的环保问题。

Dry air is fed into the bottom of the dryer. It goes from the bottom layer to the discharge vent of upper layer of the dryer. When dry air passes through the sludge surface of each layer, the moisture inside sludge is quickly vaporized into air as humidity of air increased. The near saturated air from the discharge vent of dryer is boosted pressure by fan. The dehumidification function is occurred in condenser. The air will be dried again after leaving condenser. Due to reduce the dew point temperature, vapor molecules move together to form condensation droplets collected in condensate tank. Dry air could directly go to dryer or pass air heater before go to dryer due to different sludge characteristics. The air has been continuous circulating in the system. Since there is no exhaust released to environment during CLADSD process. It is not necessary to do odor or exhaust treatment.

水循环流程 Water circulation process

冰水进入冷凝器把湿空气的热量带走成冷水后进入热泵，热泵将冷水的热量吸收成冰水，冰水再循环到冷凝器。

热水进入加热器把低温空气加热后进入干燥箱，以温水状态进入热泵，热泵将热量释放给温水成热水，热水再循环到加热器。

Iced water is pumped into condenser and taken out the heat of the air. It becomes the cold water after leaving condenser. The cold water is pumped through heat pump which adsorbed heat and make cold water to be iced water again. The iced water is circulating back to condenser.

Hot water is pumped into the air heater and release heat to air before it is fed into dryer. After leaving air heater, hot water becomes warm water. The warm water is pumped through heat pump which release heat and make warm water to be hot water again. The hot water is circulating back to air heater.

主要特点 Main Features

1. 以回收水气的潜热为理念基础，设计了热能循环再利用系统，大幅降低能耗。
2. 实现污泥含水率 70 ~ 85% 一步减量到到 10 ~ 30%，过程不需要添加药剂。
3. 实现空气零排放，空气循环为一密闭循环体系，阻绝干化过程 VOC(挥发性有机气体)、臭味气体 (硫化氢、氨、甲硫醇等) 外排。
4. 实现移动式干化平台的主机系统在 20 尺集装箱内，每日处理量可达 10 吨。
5. 实现以电为热源，不需要蒸汽或热水锅炉，将碳排放降至最低或。
6. 干燥箱的空气温度工作范围 20 ~ 80℃。
7. 可利用客户废热水或低压废蒸汽为热源，进一步节省能耗。

1. Due to recovering the latent heat of vapor concept, a thermal energy recycling system was designed to reduce energy consumption significantly.
2. To achieve the goal which 70~85% water content of raw sludge directly reduce to 10 ~ 30% in one system without any chemical dosage.
3. To achieve zero air emissions goal which air is continuous circulated in a closed loop system. There is no VOC (volatile organic gases), odor gas (hydrogen sulfide, ammonia, methyl mercaptan, etc.) discharged to environment.
4. To achieve the goal which the mobile service system design in a 20-foot container with capacity up to 10 tons sludge per day.
5. To achieve the goal which electricity plays as a sole heat source. Steam or hot water is not necessary.
6. Air temperature range inside system is 20 ~ 80 ℃ .
7. If there is enough waste hot water or waste steam with low pressure supplied by client, we can reuse it as auxiliary heat source in order to low down energy consumption rate.

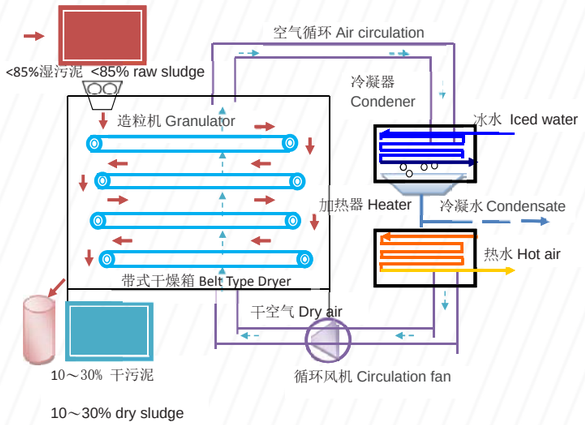
产品介绍 Product introduction

CLACSD 空气密闭循环式污泥低温除湿干化设备
CLACSD Close Loop Air Circulation Sludge Dryer

1. KSAC 系列 KSAC serial

KSAC 系列适用于含水率较高的有机污泥，污泥乾燥箱利用皮带水平输送污泥不翻搅，让污泥块在第一层皮带上表面快速乾燥，以变频调整皮带输送速度，控制污泥不会再聚合及出料的干燥度，KSAC 系列流程示意图如图一。

KSAC serial products are suitable for organic sludge with high water content. Sludge is displayed on the belt type conveyor without stirring in order to dry the surface of sludge mass quickly. It is adjustable the belt conveyor speed by motor frequency in odor to avoid sludge mass reform and get final dryness. The KSAC series flow diagram is shown as Figure 1.

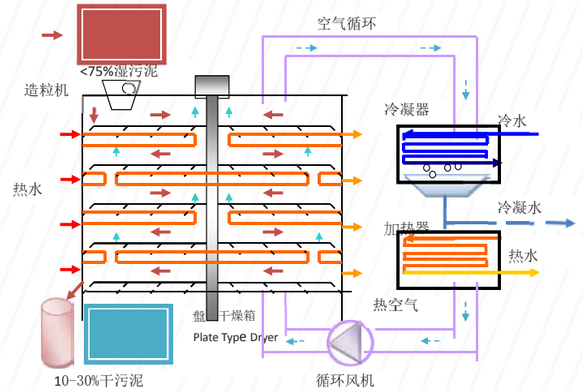


图一：KSAC 带式乾燥箱与空气密闭循环系统
Fig. 1 KSAC Belt Type Dryer and Air Close Loop Circulation

2. KSWW 系列 KSWW serial

KSWW 系列适用于成块的无机污泥或含水率低的有机污泥，污泥乾燥箱利用刮臂移动污泥并不停翻搅污泥，让污泥块快速乾燥，以变频调整刮臂转动速度，控制出料的干燥度，KSWW 系列流程示意图如图二。

KSWW serial products are suitable for inorganic sludge chunk or organic sludge cake with low water content. Sludge is moved and stirred by scraping arms in order to enhance drying efficiency. It is adjustable the scraping arm speed by motor frequency in odor to control final dryness. The KSWW series flow diagram is shown as Figure 2.



图二：KSWW 盘式乾燥箱与空气密闭循环系统
Fig. 2 KSWW Plate Type Dryer and Air Close Loop Circulation

设备选型表与基本说明 Equipment Selection and Description

型号 model	KSAB-1	KSAC-1	KSAB-3.6	KSAC-4.2
去湿量 /day Dehumidification capacity / day	900kg	1,100kg	3,600kg	4,200kg
总功率 Total power	18kw	20kw	63kw	66kw
制冷剂 Refrigerant	R134a	R134a	R134a	R134a
能效比 COP	3.9	3.9	3.9	4.0
电源 power supply	380V/50HZ	380V/50HZ	380V/50HZ	380V/50HZ
干燥温度 Drying tempera-ture	40-70℃（送风）	40-70℃（送风）	40-70℃（送风）	40-70℃（送风）
控制系统 Control System	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC
湿泥适用范围 Application range	含水率 70-90% Sludge Moisture 70-90%	含水率 70-85% Sludge Moisture 70-90%	含水率 70-90% Sludge Moisture 70-90%	含水率 70-85% Sludge Moisture 70-90%
出料含水率 Moisture of dried sludge	<30%（可调） <30% (adjustable)	<30%（可调） <30% (adjustable)	<30%（可调） <30% (adjustable)	<30%（可调） <30% (adjustable)
外形尺寸，米 Dimension, m	4.9L*2.2W*2.5H	5.3L*2.4W*2.6H	9L*2.2W*2.5H	10L*2.4W*2.6H
进料方式 Feeding type	批次 batch	连续式带机 continuous belt type	批次 batch	连续式带机 continuous belt type
结构形式 Structure type	整机 One set	2 个组件 Two sets	整机 One set	2 个组件 Two sets

注：无锡康灿环保科技有权依据技术更新换代，变更上述参数。
Note: Wuxi Kinsan Environmental Protection Technology Co., Ltd. has the right to revise the parameters according to technology improved without notices.

型号 model	KSWW-4.5	KSWW-6	KSWW-7.5	KSWW-12
去湿量 /day Dehumidification capacity / day	4,500kg	6,000kg	7,500kg	12,000kg
总功率 Total power	68kw	86kw	121kw	172kw
制冷剂 Refrigerant	R134a	R134a	R134a	R134a
能效比 COP	4.5	4.5	4.5	4.5
电源 power supply	380V/50HZ	380V/50HZ	380V/50HZ	380V/50HZ
干燥温度 Drying temperature	30-70℃ (送风)	30-70℃ (送风)	30-75℃ (送风)	30-75℃ (送风)
控制系统 Control System	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC	触摸屏 +PLC Touch screen + PLC
湿泥适用范围 application range	含水率 70-75% Sludge Moisture 70-90%	含水率 70-75% Sludge Moisture 70-90%	含水率 70-75% Sludge Moisture 70-90%	含水率 70-85% Sludge Moisture 70-90%
出料含水率 Moisture of dried sludge	<30% (可调) <30% (adjustable)	<30% (可调) <30% (adjustable)	<30% (可调) <30% (adjustable)	<30% (可调) <30% (adjustable)
外形尺寸 , 米 Dimension, m	4L*3.3W*3.0H	4L*4.3W*3.5H	4L*3.3W*3.0H	10L*5W*4.0H
进料方式 Feeding type	连续盘式机 Continuous plate type	连续盘式机 Continuous plate type	连续盘式机 Continuous plate type	连续式带机 continuous belt type
结构形式 Structure type	2 个组件 Two sets	2 个组件 Two sets	2 个组件 Two sets	2 个组件 Two sets

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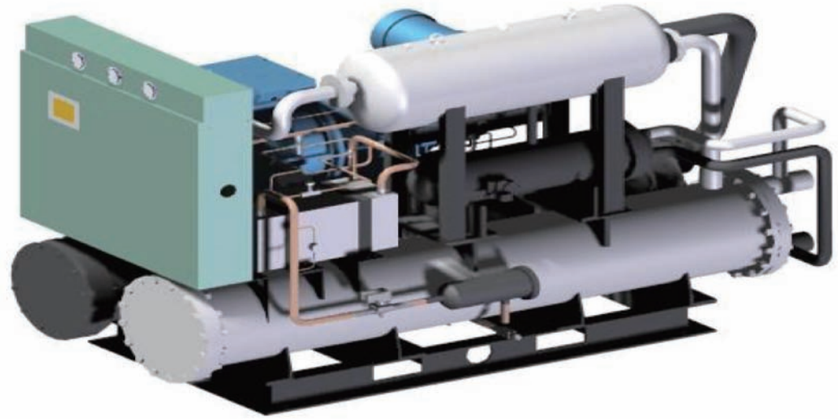
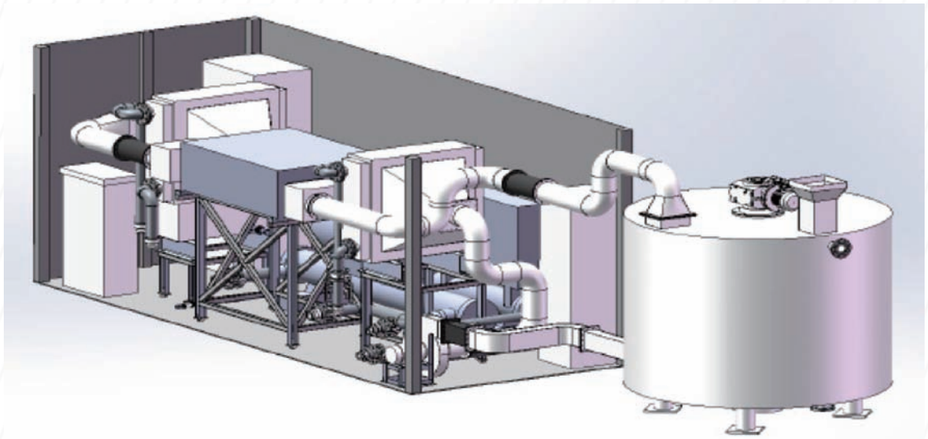


工业用热泵
Industrial Heat Pump



CLACSD 空气密闭循环式污泥干化系统图
CLACSD Close Loop Air Circulation Sludge Dryer System Drawing