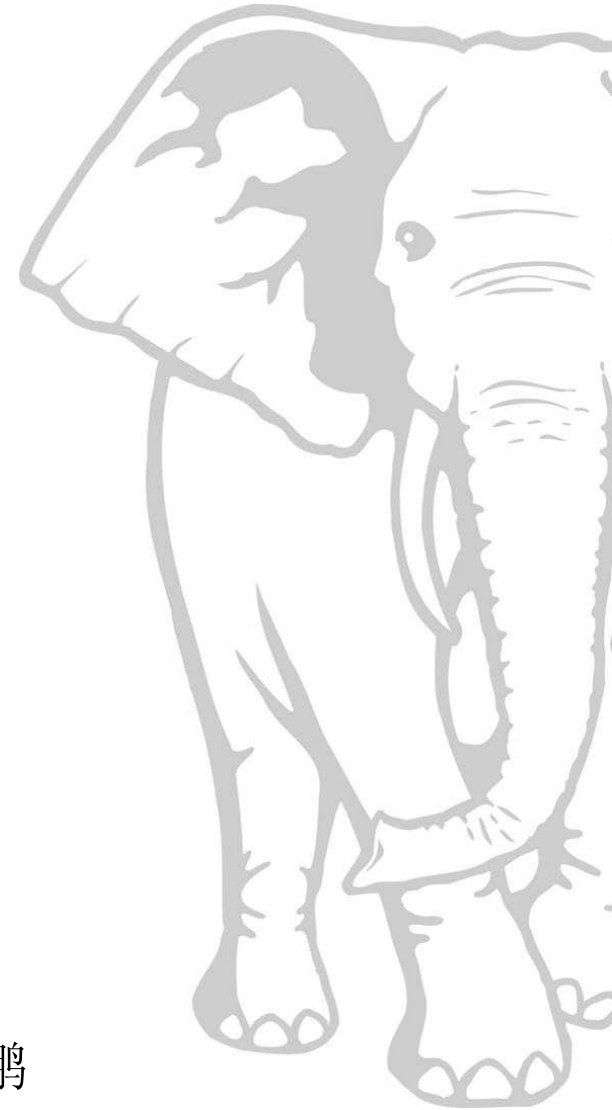


Analysis for Transportation Technology of Biomass 生物质输送技术探讨

**Performance and Support Policy of
Biogas Energy generating Biogas Plants**

16th to 18th May 2012, Nanjing

i. V. **Rüdiger Dalhoff**, Dipl.-Ing. , 闫浩, 秦鹏



❑ Definition of Biomass

生物质的定义

❑ Comparison of different transportation methods

不同输送方式的比较

❑ Putzmeister technology for Biomass Transportation

普茨迈斯特生物质输送技术

❑ Different processes of treating Biomass in detail

不同的生物质处理工艺详述

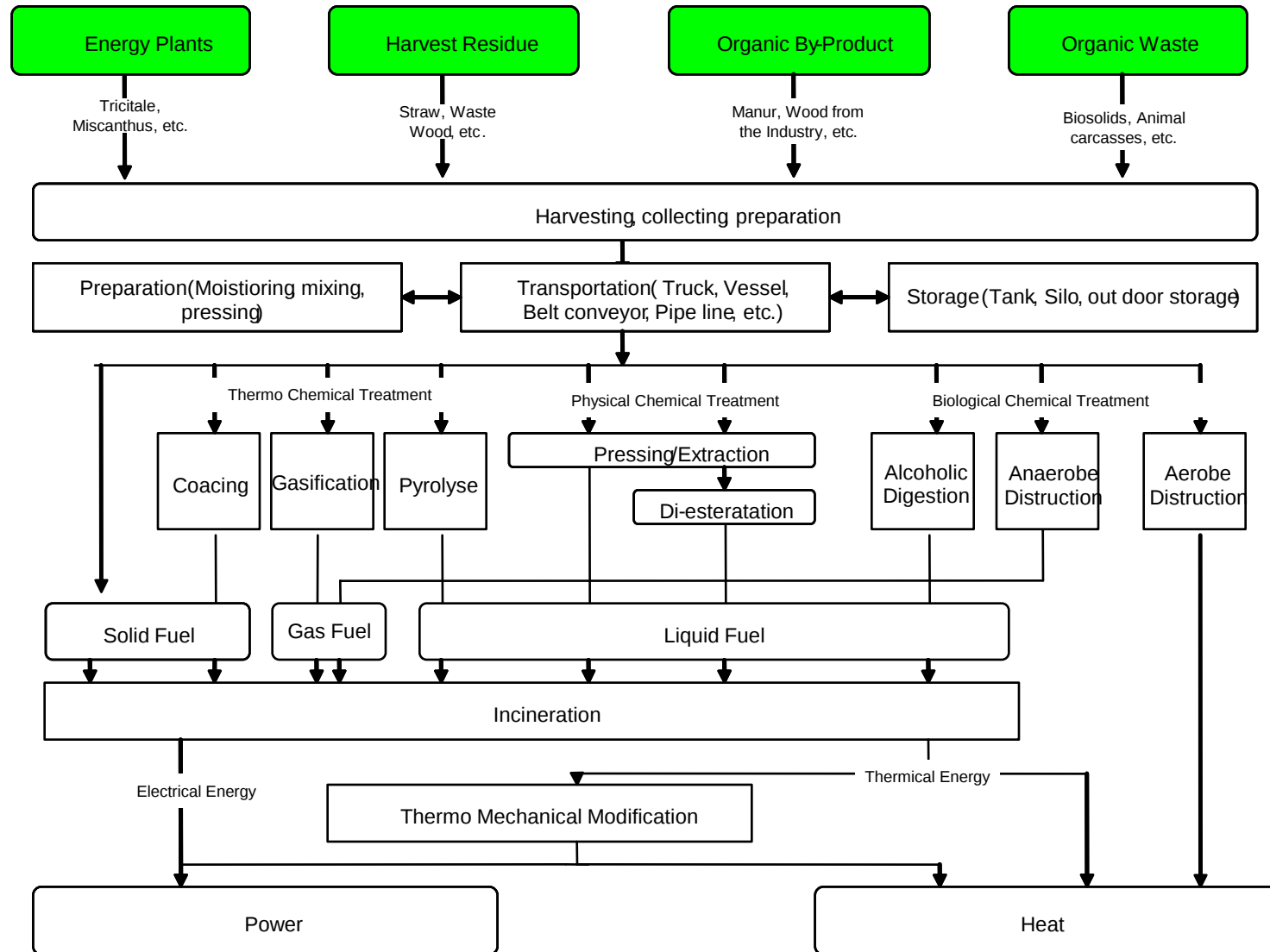
- Renewable energy (NaWaRo) 可再生能源
- Green household residue 有机生活垃圾
- Food waste and food with expired storage time 食品废物及过期的食品
- Using animal excrement as an energy source 使用动物粪便作为能源
- Biomass conversion into carbon or crude oil 生物质碳化或制油

❑ Conclusion

结论

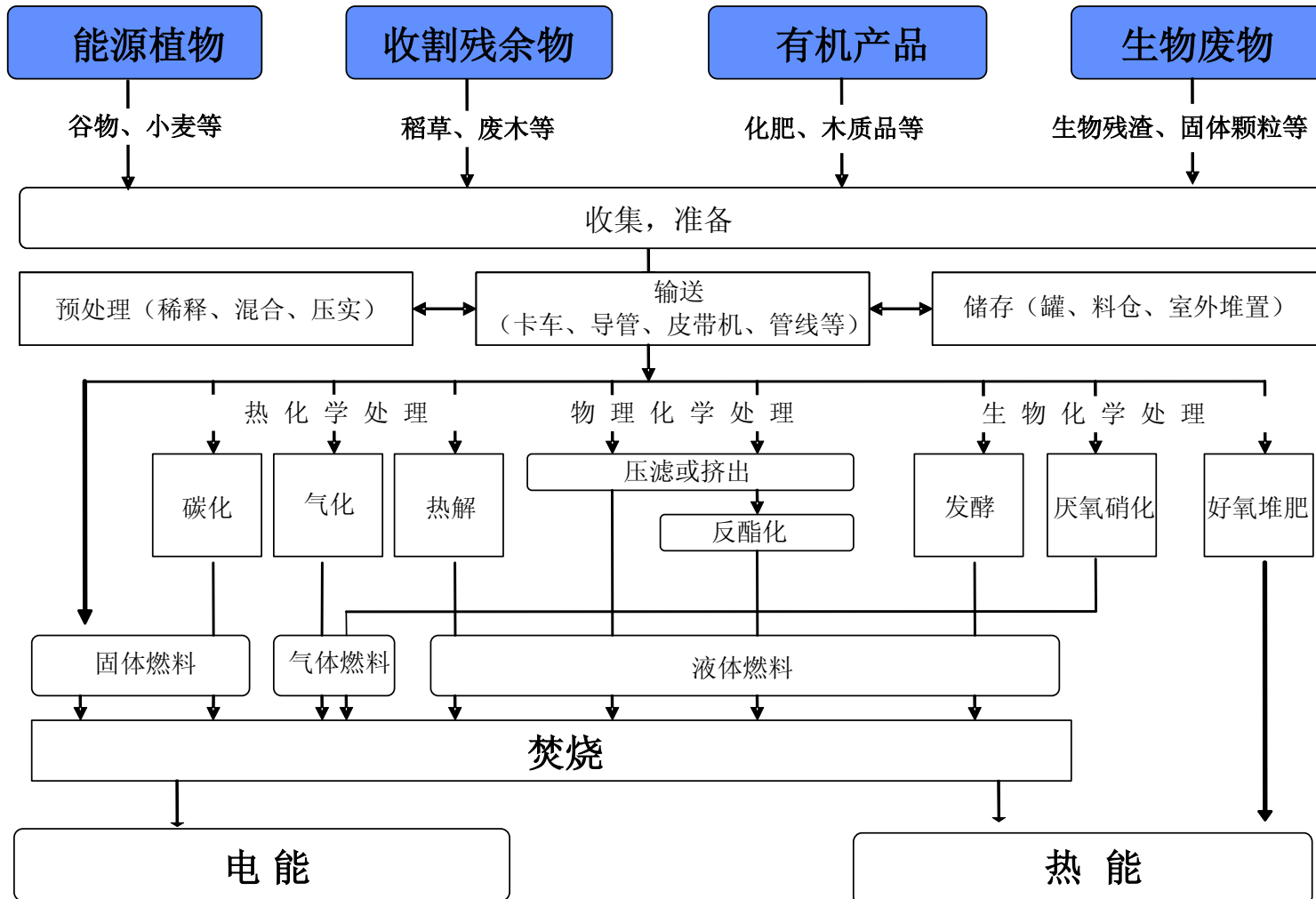
Definition of Biomass 生物质定义

Putzmeister



Definition of Biomass 生物质定义

Putzmeister



Parameters 生物质输送特点 for Biomass-Transportation

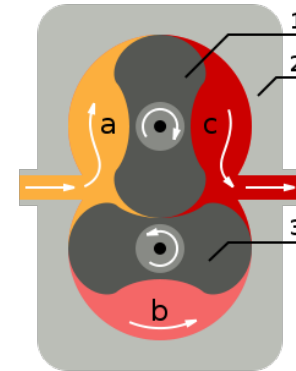
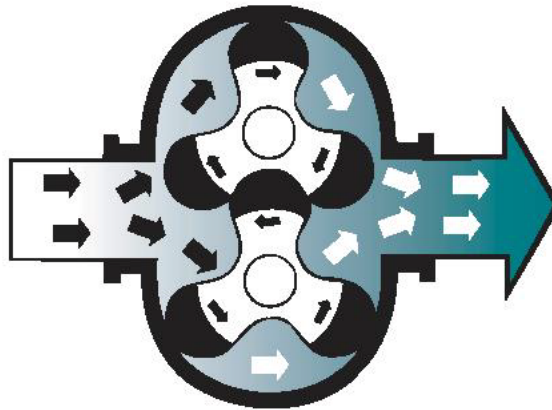
Putzmeister

- ❑ Biomass are containing all kind of foreign particles 生物质中存在着杂物
- ❑ Different types of Pumps are more or less suitable for Biomass transportation 不同的泵送装置对于生物质输送的适应性不尽相同
- ❑ Pumping Systems with Valves are not required 带有阀门的泵送装置是不适用的
- ❑ Pumps have to be designed for heavy duty use 泵送装置需要设计用于高负荷运转
- ❑ Pumps have to be designed for low Life Cycle Costs compare to other transportation systems. 与其他输送系统相比，在设计泵送装置时应遵循低生命周期成本的原则
- ❑ Pumps have to be adjustable to process and material parameters, also during operation 在运行过程中，泵送装置必须适应工艺和物料条件
- ❑ Due to many different types of biomass pump supplier must have wide and deep experience with pumping such substrates 不同类型的泵送装置供应商应具备针对此类物质的丰富实践经验
- ❑ The pipe line has to be hermetically sealed -> no leakage or smell to the environment 封闭式管路系统，无泄漏或臭气

Rotary Lobe pumps 转子泵

Putzmeister

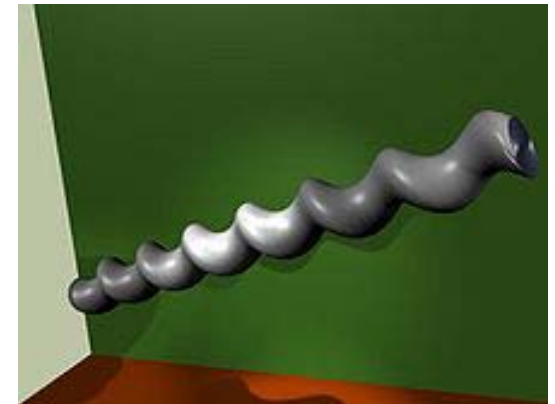
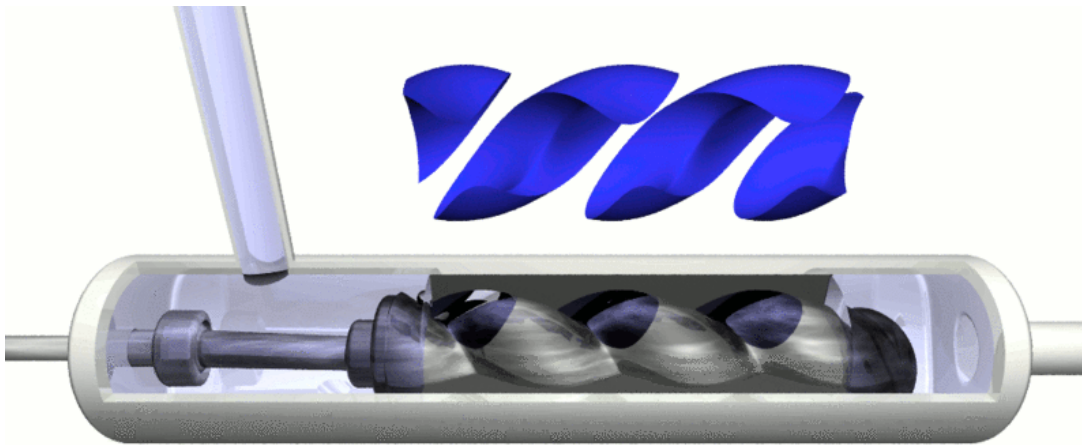
- Lobe pumps are basically used in a variety of industries including pulp and paper, chemical, food, beverage, pharmaceutical, and biotechnology 转子泵广泛应用于纸浆和造纸，化工，食品，饮料，医药和生物科技领域；
- Rotary pumps can handle solids (e.g., cherries and olives), slurries, pastes, a variety of liquids. 转子泵可用于输送固体（例如：樱桃和橄榄），浆体，膏体等多种流体；
- If wetted, they offer self-priming performance. 对于潮湿物料具备自吸功能；
- A gentle pumping action minimizes product degradation. 温和的泵送降低设备磨损；
- They also offer continuous and intermittent reversible flows 可实现连续与间歇可逆流；
- can operate dry for brief periods of time (depending on seal-version). 大部分时间可空载运行（取决于密封）
- Flow is relatively independent of changes in process pressure, 压力与排量相对情况下互不干扰
- output is relatively constant and continuous. 出料连续



Screw pump 螺杆泵

Putzmeister

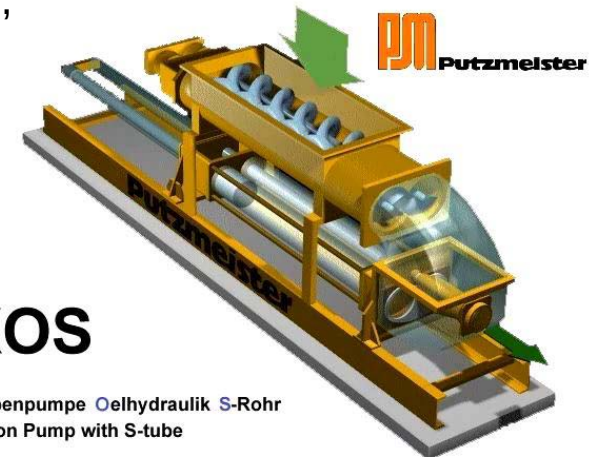
- Excentric screw pumps are basically used in a variety of industries including Food and drink pumping, Oil pumping, Slurry pumping, Sewage sludge pumping, Viscous chemical pumping 螺杆泵的应用领域十分广泛，包括食品和饮料行业，油品泵送，浆体泵送，污泥和多种化工品的泵送
- Excentric screw pumps can handle nearly no solids, only slurries, pastes, a variety of liquids 螺杆泵几乎不能应用于固体物料泵送，而仅是浆体、膏体和各种液体
- If wetted, they offer self-priming performance. 对于潮湿物料具备自吸功能；
- A gentle pumping action minimizes product degradation. 温和的泵送降低设备磨损；
- They also offer continuous and intermittent reversible flows 可实现连续与间歇可逆流；
- can operate dry for brief periods of time (depending on seal-version). 大部分时间可空载运行（取决密封）
- Flow is relatively independent of changes in process pressure, 压力与排量相对情况下互不干扰
- output is relatively constant and continuous. 出料连续



Solid pump 固体泵

Putzmeister

- Piston pumps are basically used in a variety of industries including hazardous waste pumping, Oil-sludge pumping, Slurry pumping, Sewage sludge pumping, dredging and tailings pumping 柱塞泵应用于多种工业领域包括危险废物处理，油泥泵送，浆体泵送，污泥泵送清淤和尾矿泵送
- Solid pumps can handle solids like stones sand, metal parts, glass, plastic etc. 适应于沙石、金属部件、草和塑料等等杂物存在的情况下；
- A gentle pumping action minimizes product degradation. 温和的泵送降低设备磨损；
- They also offer continuous and intermittent reversible flows 可实现连续与间歇可逆流；
- can not operate dry for long periods of time. 不得长期空载运行
- Flow is totally independent of changes in process pressure, 排量完全不受压力变化的影响
- output is relatively constant and continuous. 出料相对连续



KOS

Kolbenpumpe Ölhydraulik S-Rohr
Piston Pump with S-tube

Comparison of different pump types

不同类型泵的比较

Putzmeister

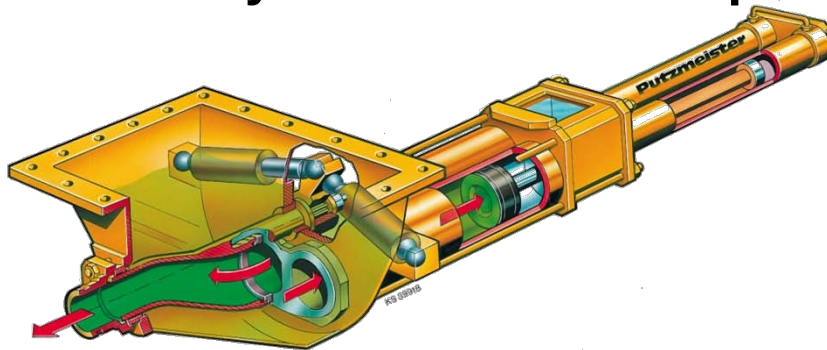
	Piston pump 柱塞泵	Lobe pump 转子泵	Screw pump 螺杆泵	Shredder pump 切割泵
Size of particles 物料粒径	2/3 of diameter of cylinder 缸径2/3		Max. 10 mm 最大10mm	
Pressure 输送压力	Up to 100 bar 可达100bar	Up to 20 bar 可达20bar	Up to 20 bar 可达20bar	
% of DS 含固率	Up to 35 % 可达35%	Up to 20% 可达20%	Up to 20% 可达20%	
Foreign particles 杂物存在	Yes 允许	Only small amount 仅少量允许	Nearly nothing 基本不允许	Not recommended 不建议
Pretratment of Biomass 生物质的预处理	Mostly Not necessary 大部分不需要	Mostly necessary 大部分都必须	Mostly necessary 大部分都必须	
Wear 磨损	Low 低	Depending on substrate 取决于物料	Depending on substrate 取决于物料	
Power consumption 电耗				
Invest 投资				

Main types of Piston Pumps for Biomass-Transportation

用于生物质输送的柱塞泵主要类型

Putzmeister

Double Cylinder Piston Pump 双缸柱塞泵

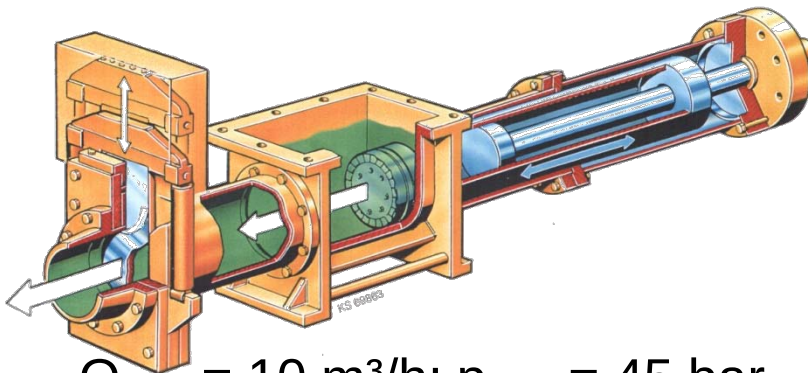


$$Q_{\max} = 400 \text{ m}^3/\text{h}; p_{\max} = 100 \text{ bar}$$



Kitchen Waste or Energy Plant mixed with manure 餐厨垃圾或能源植物与动物粪便混合

Single Cylinder Piston Pump 单缸柱塞泵



$$Q_{\max} = 10 \text{ m}^3/\text{h}; p_{\max} = 45 \text{ bar}$$



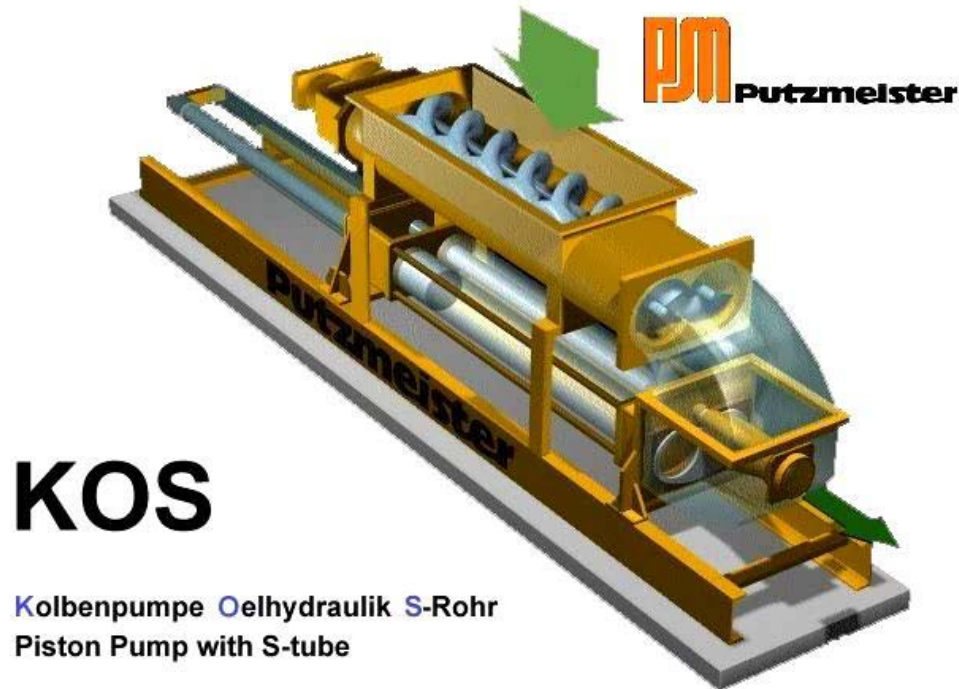
Corn Stover and straw are chopped and steamed 破碎和蒸煮的青储和秸秆

PM Piston Pump Type KOS

普茨迈斯特KOS型柱塞泵

Putzmeister

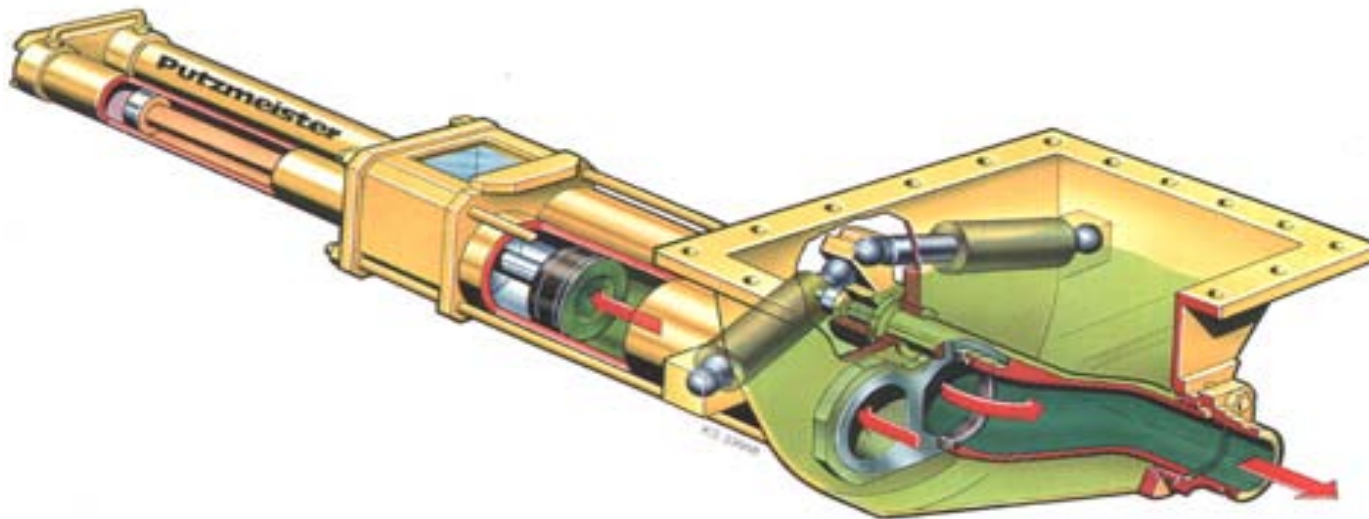
Kolbenpumpe Oelhydraulik S-Rohr
(Piston Pump with S-tube)



Piston pumps with hydraulically actuated S-Tube 配备液压驱动S摆管的柱塞泵

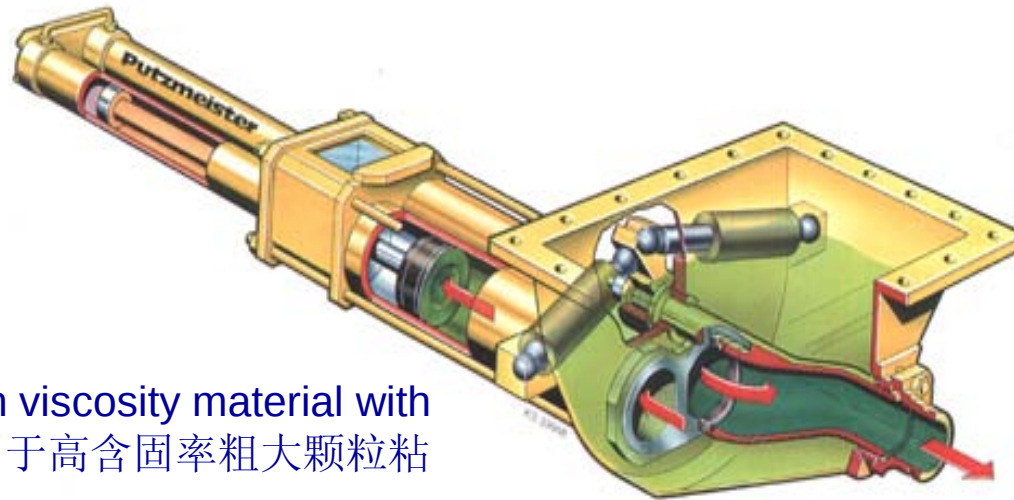
Putzmeister

- Discharge pressure up to 100 bar 输送压力可达100bar
- Flow capacity up to 440 m³/h 排量可达440方/小时
- Designed for continuous operation. Under severe conditions, many KOS pumps have attained more than 160,000 hours in continuous trouble-free operation 设计用于连续运行。在不同的使用条件下，多数KOS泵可实现超过16万小时连续无故障运行

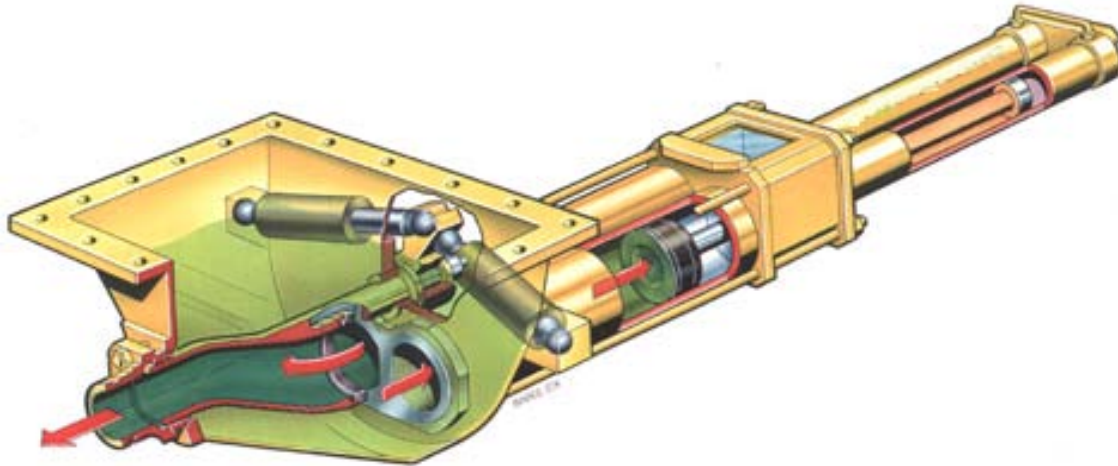


KOS

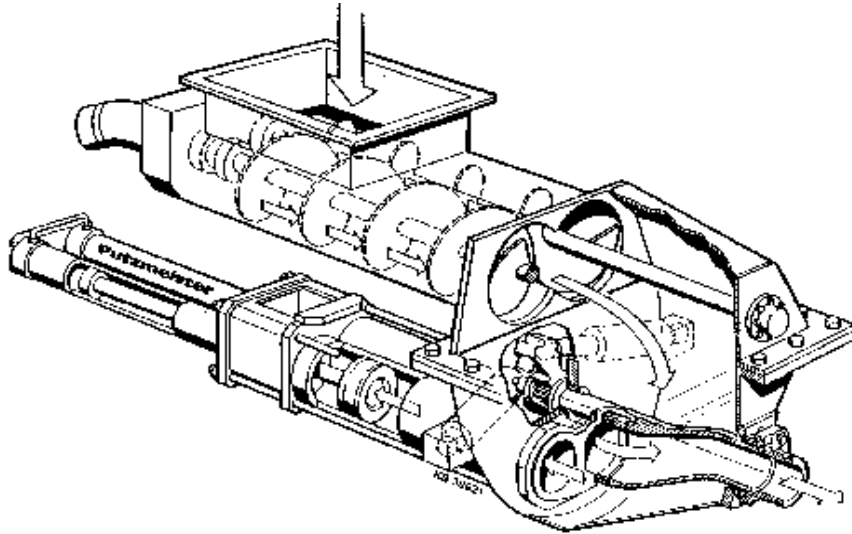
- For coarse-grained high viscosity material with high solids content 应用于高含固率粗大颗粒粘稠物料
- Minimum maintenance and wear resulting from moving parts 移动部件极少量的磨损和维护需求
- Hydraulic circuit separated from abrasive pumpage assure reliability 液压循环系统与敏感物料完全隔离以确保可靠性
- Individual foreign bodies in the material can easily be conveyed with a particle size of up to 80 % of the outlet diameter 粒径大小在出口管径80%以内的杂物可以被轻易的泵送



KOS double piston pump KOS双柱塞泵 **Putzmeister**



- Wear-resistant “Chrome-Molly” steel S-transfer tube service life of up to several thousand hours 耐磨镀铬钢(60HRC)S摆管服务寿命长达数千小时
- Discharge diameter is 100 mm up to 300 mm 出料管径从100到300mm
- Standard stroke length of 700 mm to 2,500 mm. Piston diameter of 120 mm to 560 mm 标准冲程长度从700到2500mm，缸径从120到560mm
- KOS pumps have free passage without any troublesome resistance to flow. They can thus suck in also stiffest of sludge 泵结构满足足够流畅的、无阻碍的物料通过需求，即使最粘稠的物料也可实现自吸功能



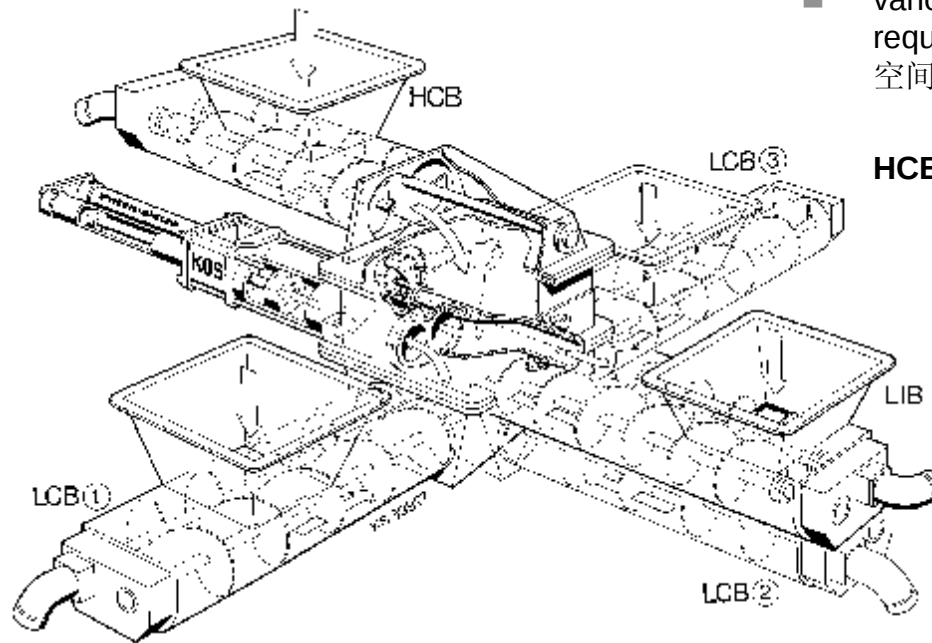
Feeding device THS 給料装置 Trough Horizontal Screw

- hydraulically or electrically driven augers 液压或电驱动的螺旋
- bearings at both ends in most configurations 多数结构两端都配备轴承
- augers are intermeshing for self-cleaning 具备自清洁功能
- for stiff pump age high torque drives are available 针对粘稠泵送情况下，可实现高扭曲驱动

Features and function 特点和功能

Putzmeister

HCB
High Cross Booster



LCB
Low Cross Booster

Feeding device THS 給料装置THS

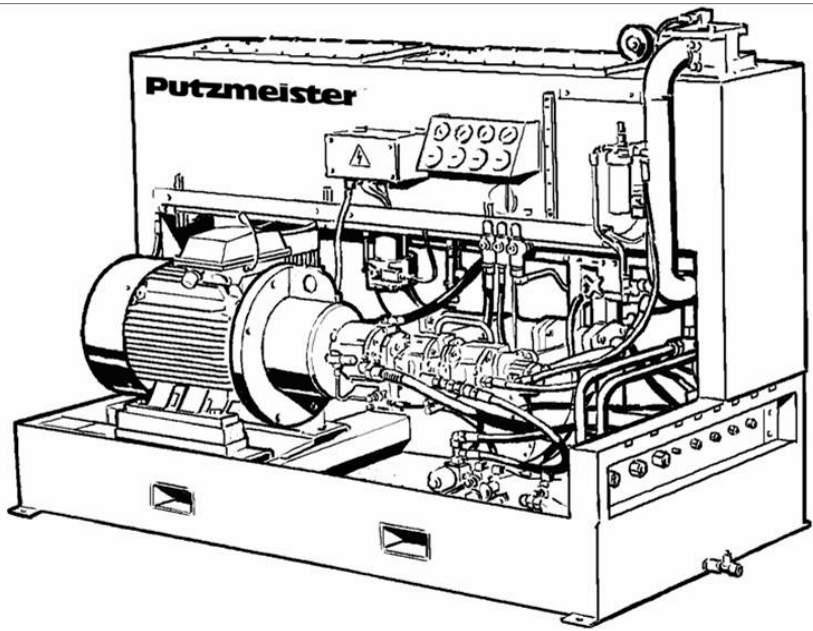
Trough Horizontal Screw

- various THS configurations are available to meet site specific requirements such as: 不同的THS结构适应于不同的现场使用空间需求

HCB high cross booster and LIB low cross booster

Hydraulic Power Unit HA 液压站 HA

Hydraulik Aggregat



- hydraulic power unit from 11 kW up to 400 kW are available 液压站自11KW至400KW均可实现
- two hydraulically circuit are possible 两类液压循环系统均可实现
 - open loop design 开式液压回路
 - closed loop design 闭式液压回路
- hydraulic oil pumps are in „inline“ configuration 液压油泵为直线串联布置

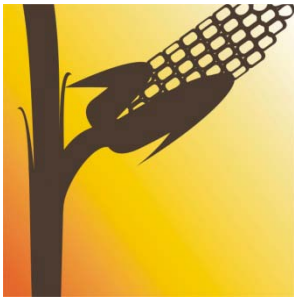
General Application 应用领域

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Dewatered sewage sludge with high solids content and fibrous, stringy material impact

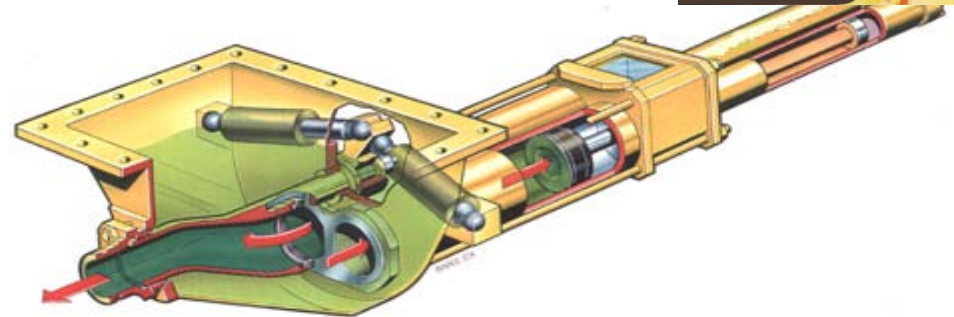
高含固率，高纤维含量，高粘稠脱水污泥



Organic materials with abrasive solids 磨蚀性的有机固体物料

Various high density hazardous wastes

高浓度的危险废物



High solids (up to 70%) minerals slurries with some coarse particles in a minus 500 micron matrix 高含固率（70%）矿浆



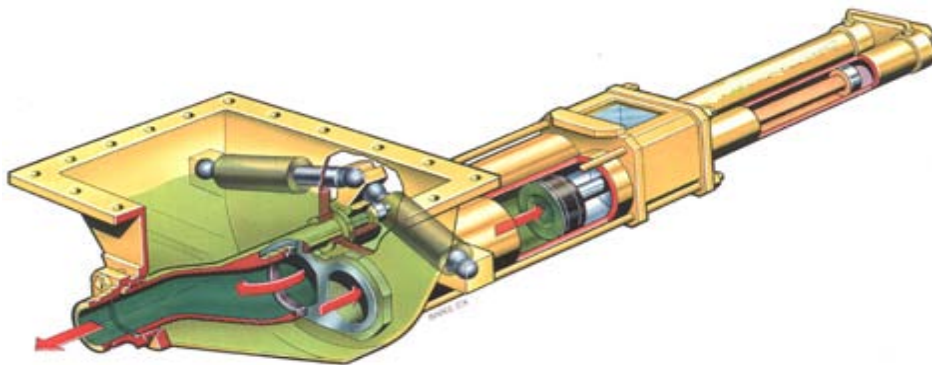
General Application:

Putzmeister



Dredging material with low water content and unexpected foreign bodies like stones etc. 清淤物料，尽管其中存在低含水率物料和不可预期的杂物

High abrasive solids like coal paste or fly ash 高磨蚀性的固体物料例如煤泥和飞灰

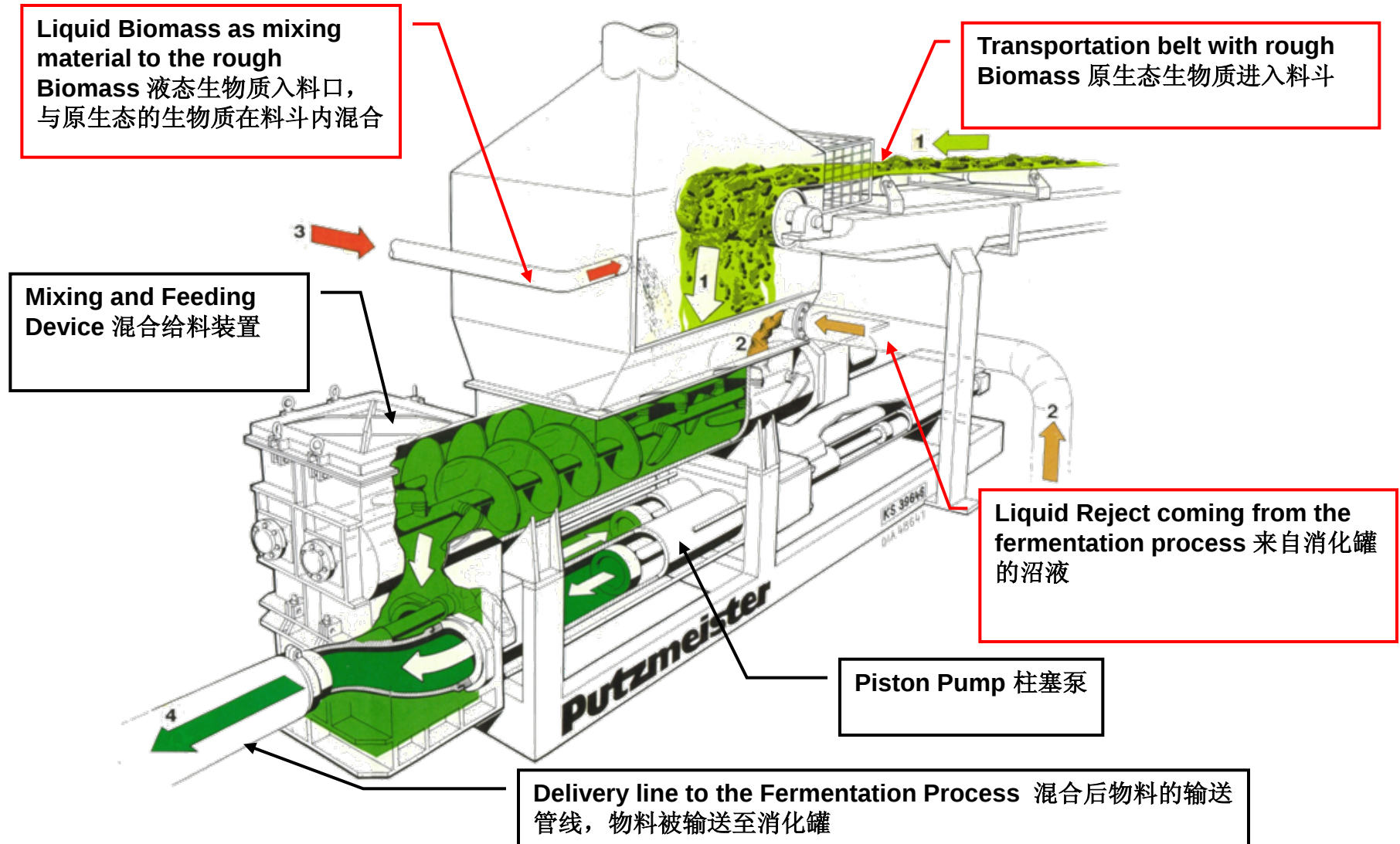


High solids (up to 70%) minerals slurries

高含固率（70%）的钻井岩屑



Benefit from using Piston Pumps for Biomass-Transportation 柱塞泵输送生物质的优点 **Putzmeister**

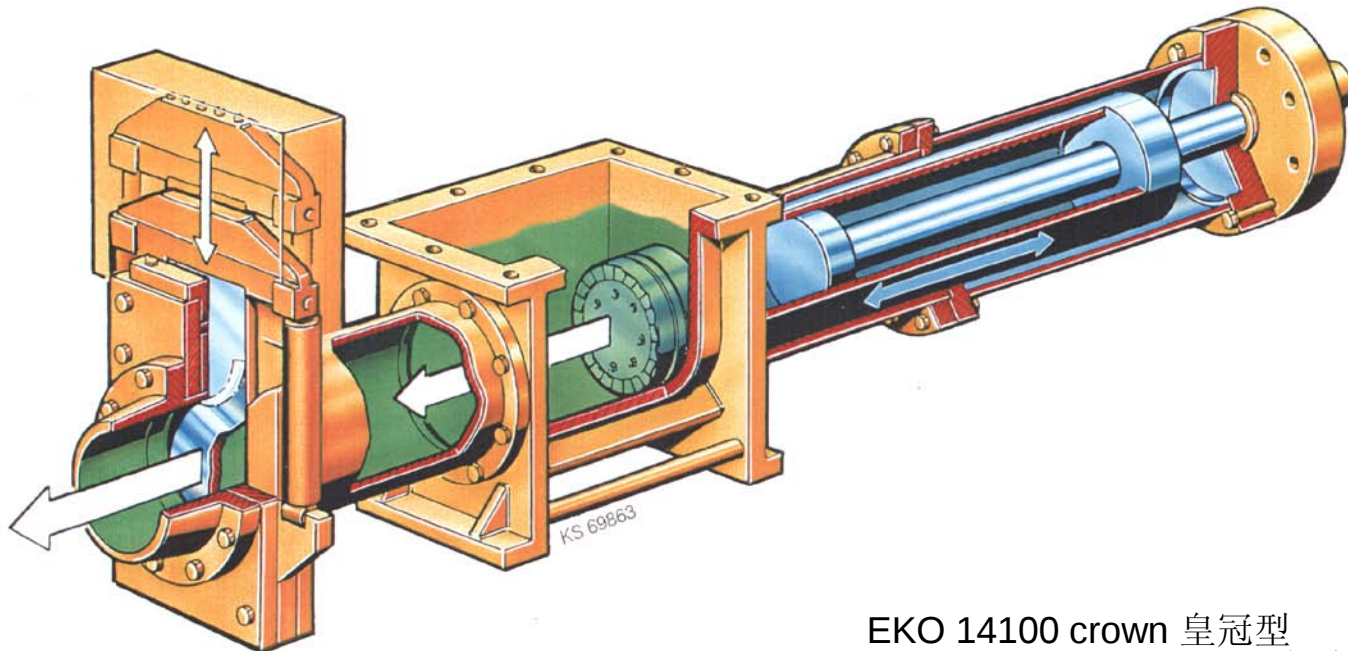


PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister

- EKO 14100 Crown 皇冠型(with hydraulically driven gate valve 配备液压驱动闸板阀)
- EKO 1060 (with lamellar finger non-return valve 配备薄片止回阀)
- EKO 1060 PP

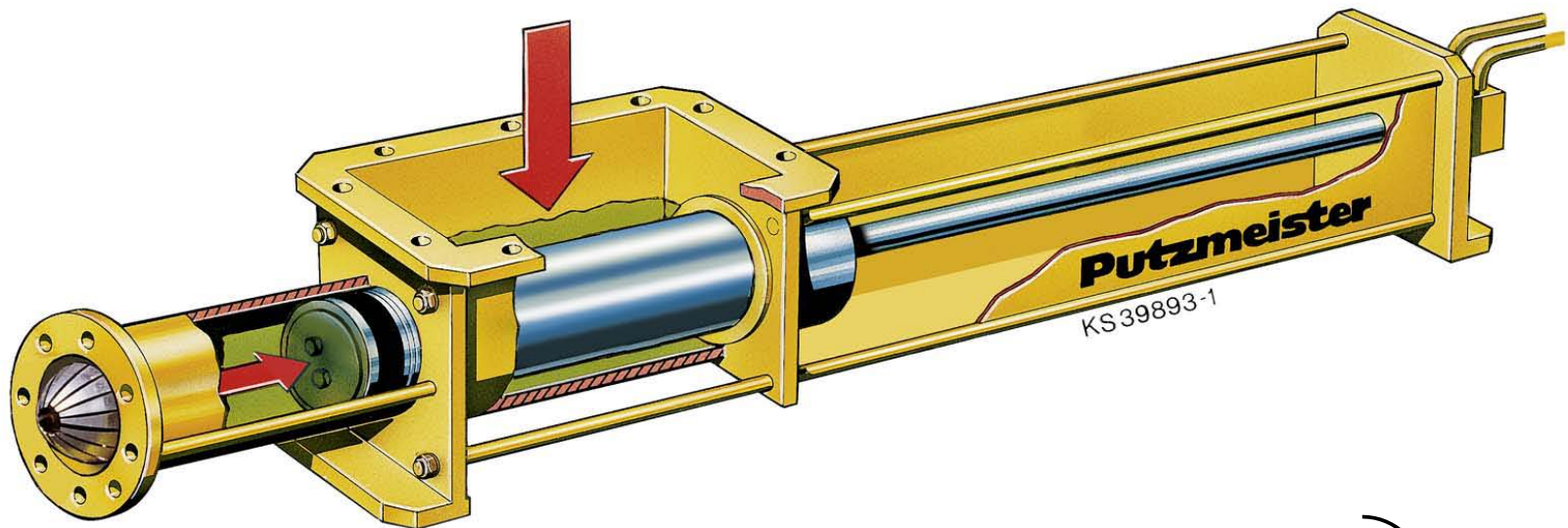


EKO 14100 crown 皇冠型
with hydraulically driven gate valve 配备液压闸板阀

PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



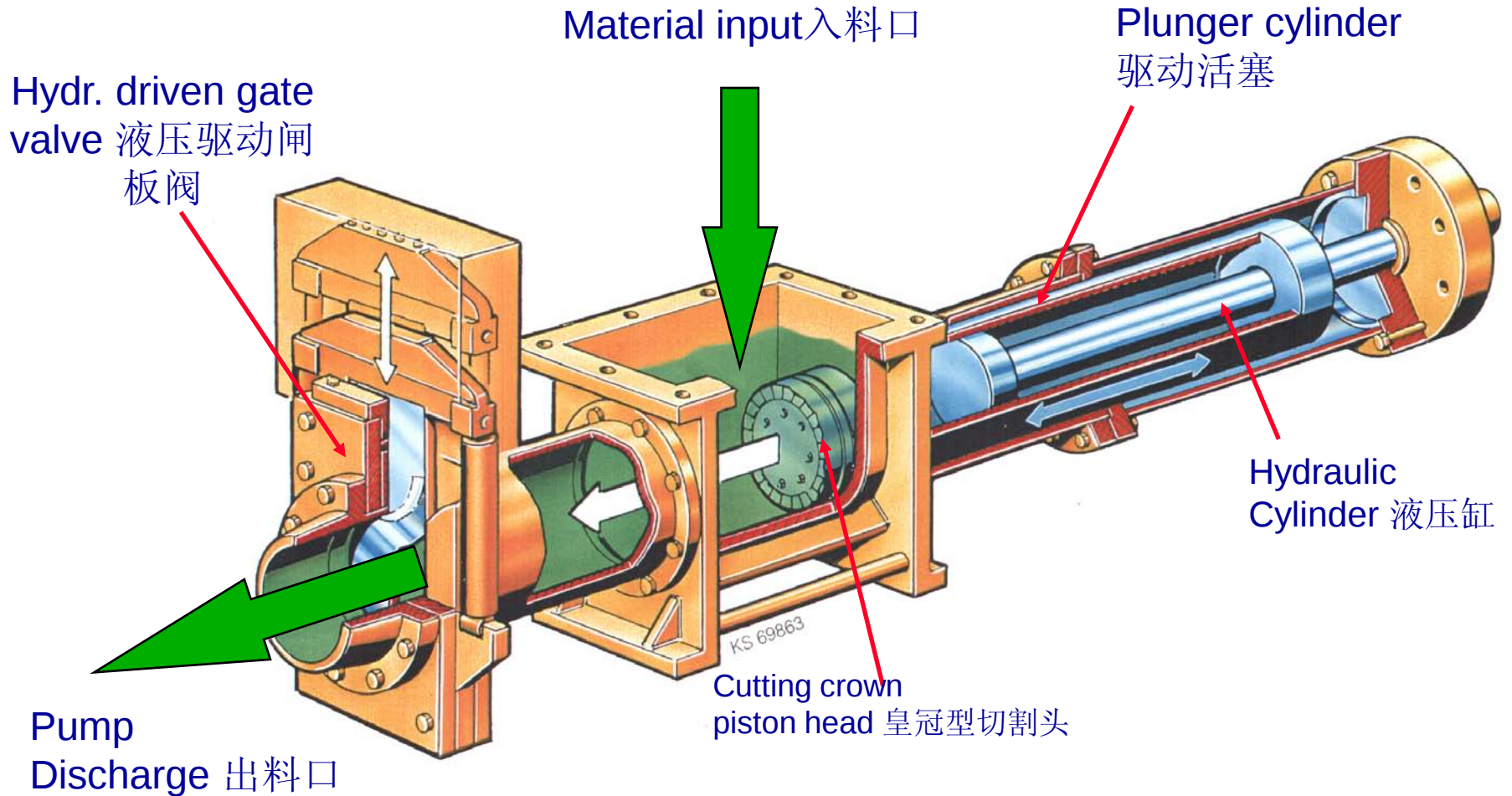
EKO 1060
available with the lamellar finger non-return valve
配备薄片止回阀的EKO1060单柱塞泵



PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

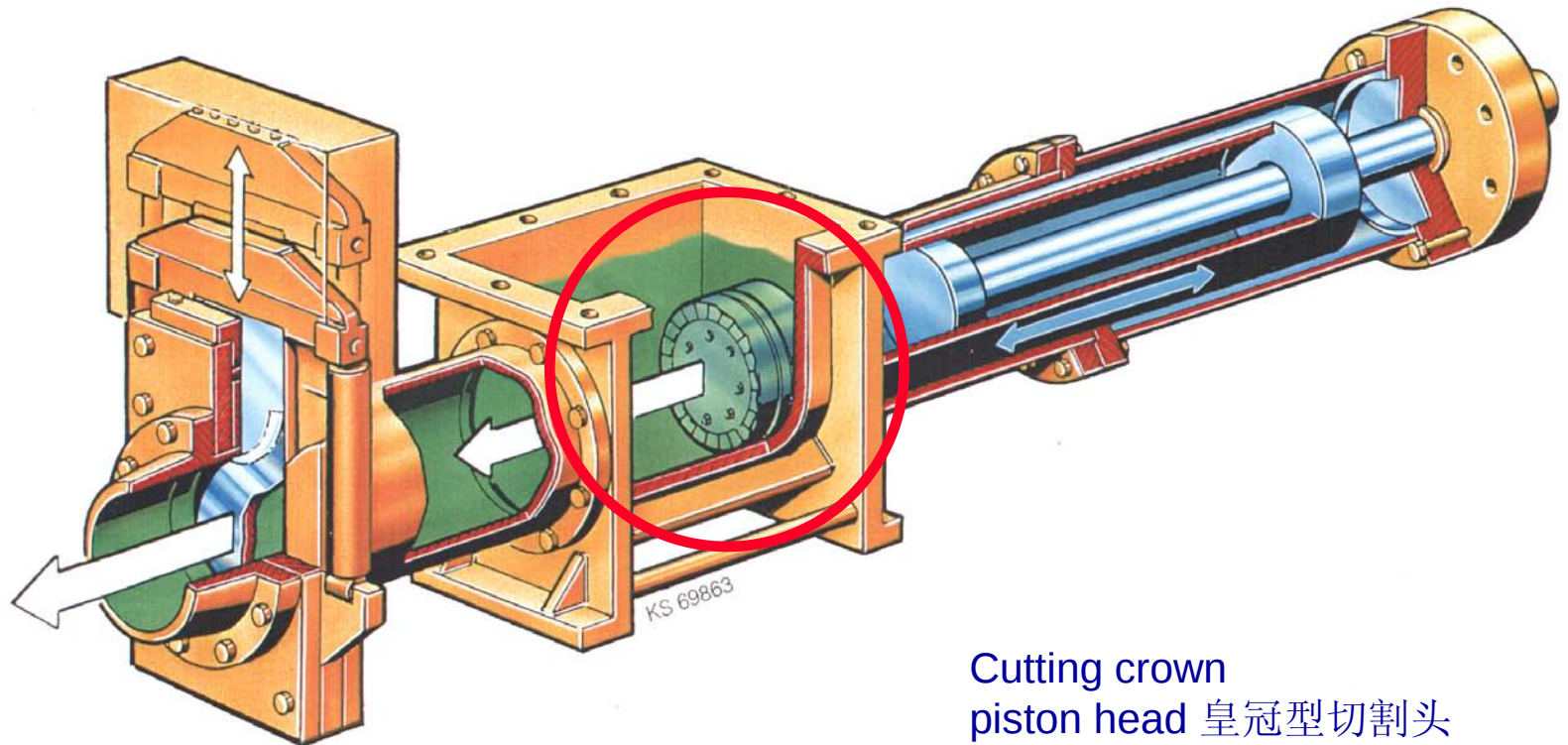
Putzmeister



PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

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Cutting crown
piston head 皇冠型切割头

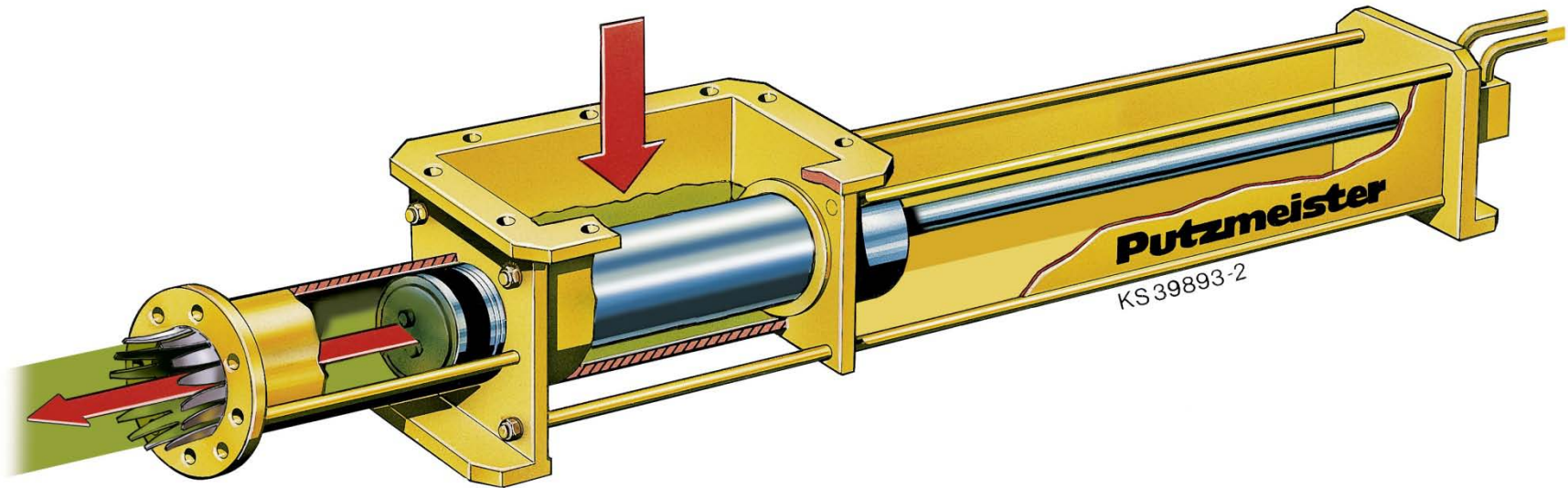
PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister

Parts patented by 专利技术

Putzmeister

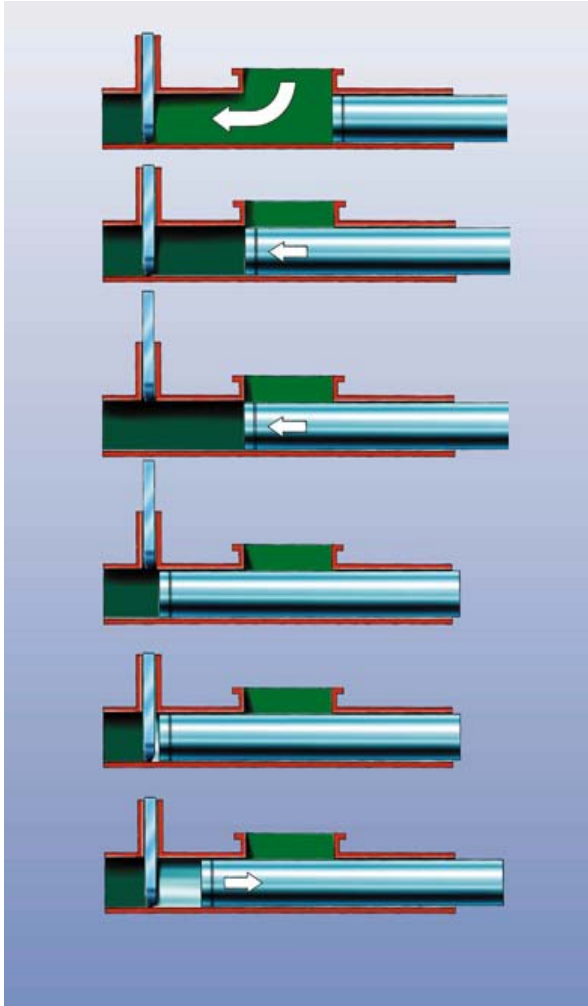


Lamellar finger non-return valve 薄片止回阀

PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



1. A hydr. drive cylinder moves the piston forward and backward. As the piston is retracting, the feed chamber is filled. 液压缸推进，物料进入
2. The piston pushes the material out of the feed chamber into the supply cylinder, and then stops. 活塞将物料推进输送缸，然后停止
3. The slide valve opens. 出料阀打开
4. The hydraulically driven piston delivers the material into the pipeline. 活塞将物料推进管道
5. The gate valve closes, preventing any reverse flow of material. 闸板阀关闭，防止物料回流
6. The piston returns to its starting position, thus opening the feed chamber allowing the material to enter 活塞退回初始位置，入料口开放



- **Food Waste are residue due to the preparation of a Meal and waste in the Kitchen**

来自于厨房的食品废物<厨余>

This Waste contain beside organic fractions also a lot of foreign particles like Knives, Plates, Plastic, glass, Metal cups and similar 此类废物在包含有机碎片的同时也存在非常多的杂物，例如刀具，盘子，塑料，玻璃，金属杯等等

PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



Hydr. Gate Valve
液压闸板阀

**Perforated Delivery
Cylinder** 带滤孔的输送缸

PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister

Pump installation at BioPower, Bernau 项目实例，位于Bernau

Test 测试	Input 入料	Pressed Material 压缩后的残留物料	Ratio Pressed/Input 残留率
Food Waste not shredded 未经破碎的食品垃圾	420 kg	90 kg	21 %
Food Wasted shreddes with a knife width 19 mm 经19mm刀头破碎后的食品垃圾	310 kg	40 kg	13 %
Pressed material out of Test 残留物	130 kg	30 kg	23 %

PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



Substrate

基质

PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



Reject with Foreign Particles

分离出的杂物

PM Singe Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



PM Single Piston Pump Type EKO

普茨迈斯特EKO单柱塞泵

Putzmeister



Shredded food waste

破碎后的食品垃圾



Reject 残余物

Benefit from using Piston Pumps for Biomass-Transportation 柱塞泵输送生物质的优点 **Putzmeister**

- ❑ Biomass are containing all kind of foreign particles 生物质中存在各种杂物
- ❑ Double Cylinder Pumps as well as the Single Cylinder Pumps are suitable for Biomass 单柱塞泵及双柱塞泵适合于生物质泵送
Pumping Systems with Valves are not required 带有阀体的泵送系统无法适应
- ❑ Piston Pumps are designed for heavy duty use 柱塞泵设计于重负荷应用
- ❑ Piston Pumps are known for low Life Cycle Costs compare to other transportation systems. Proven for example out of the hazardous waste industry 区别于其他输送系统，柱塞泵以低生命周期成本而闻名。这一点由危险废物处理领域得到印证。
- ❑ Putzmeister has more than 25 years experience with transportation of Biomass 普茨迈斯特拥有超过25年的生物质应用经验
- ❑ The pipe line is hermetically sealed -> no leakage or smell to the environment 管道完全密封-> 无遗洒，无异味，无环境二次污染



- ☐ **Renewable energy (NaWaRo)**
再生能源（可再生能源物料）
- ☐ **Green household residue**
绿色家庭垃圾
- ☐ **Food waste and food with expired storage time**
食品垃圾和过期食品
- ☐ **Using animal excrement as an energy source**
使用动物粪便作为能源
- ☐ **Biomass conversion into carbon or crude oil**
生物质转化为碳或生物柴油

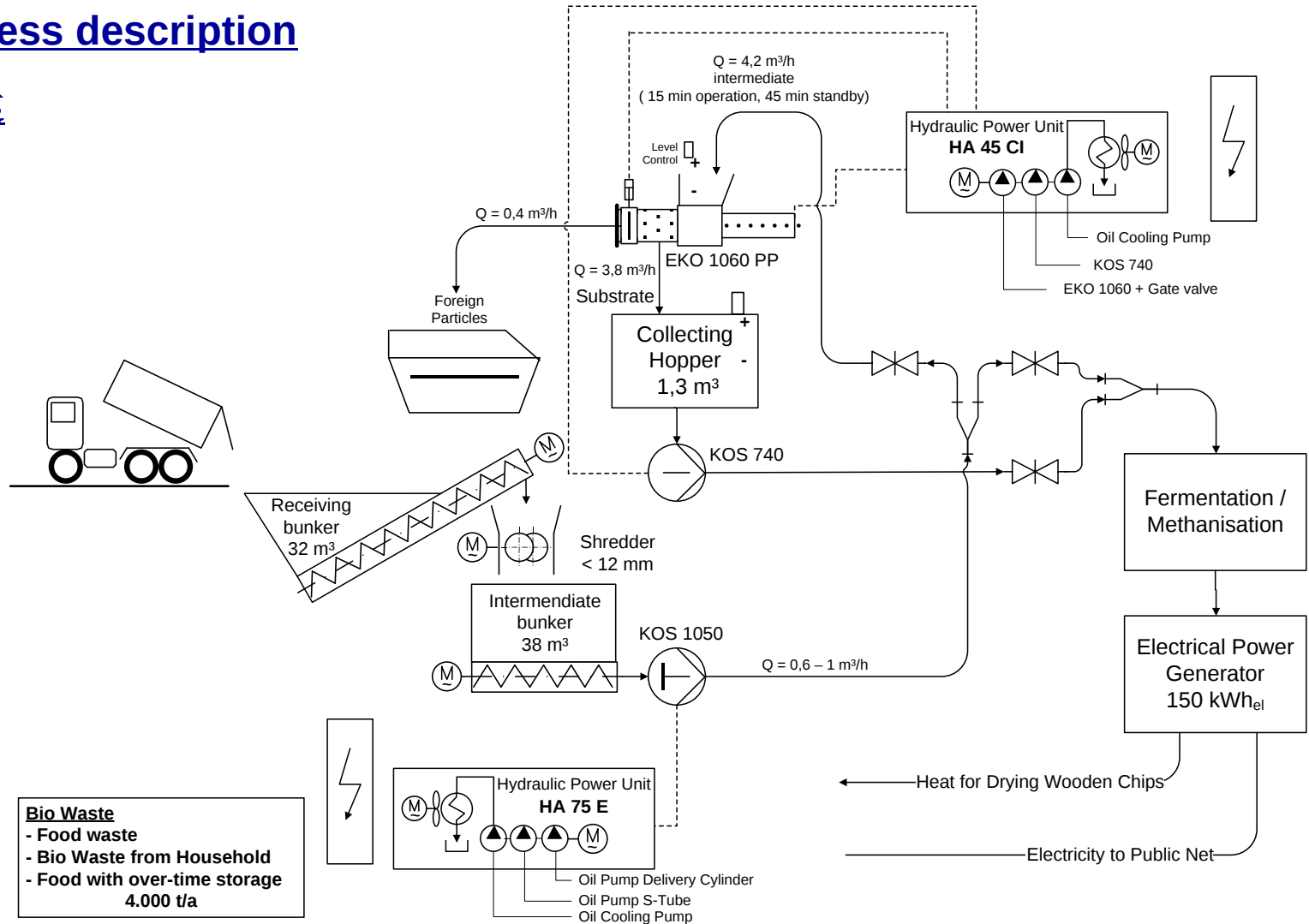
Food Waste Methanization at the 食品垃圾厌氧消化 MUT Plant / Kössen – Austria 位于奥地利Kössen – Austria的MUT沼气厂

- **Plant Size: max. 10.000 to/a. In Average 6.000 to/a**
规模1万吨/年，平均6000吨/年
- **Modulas System. Combined Installation in a Area of 100 up to 200 km** 模块化系统，集合了周边100至200公里的处理设施



Total Process description

总工艺描述







Received Food waste with expired storage time. 收集到的过期食品垃圾

This material will be shredded to a particle size not larger than 12 mm. 物料被破碎至12mm 以下

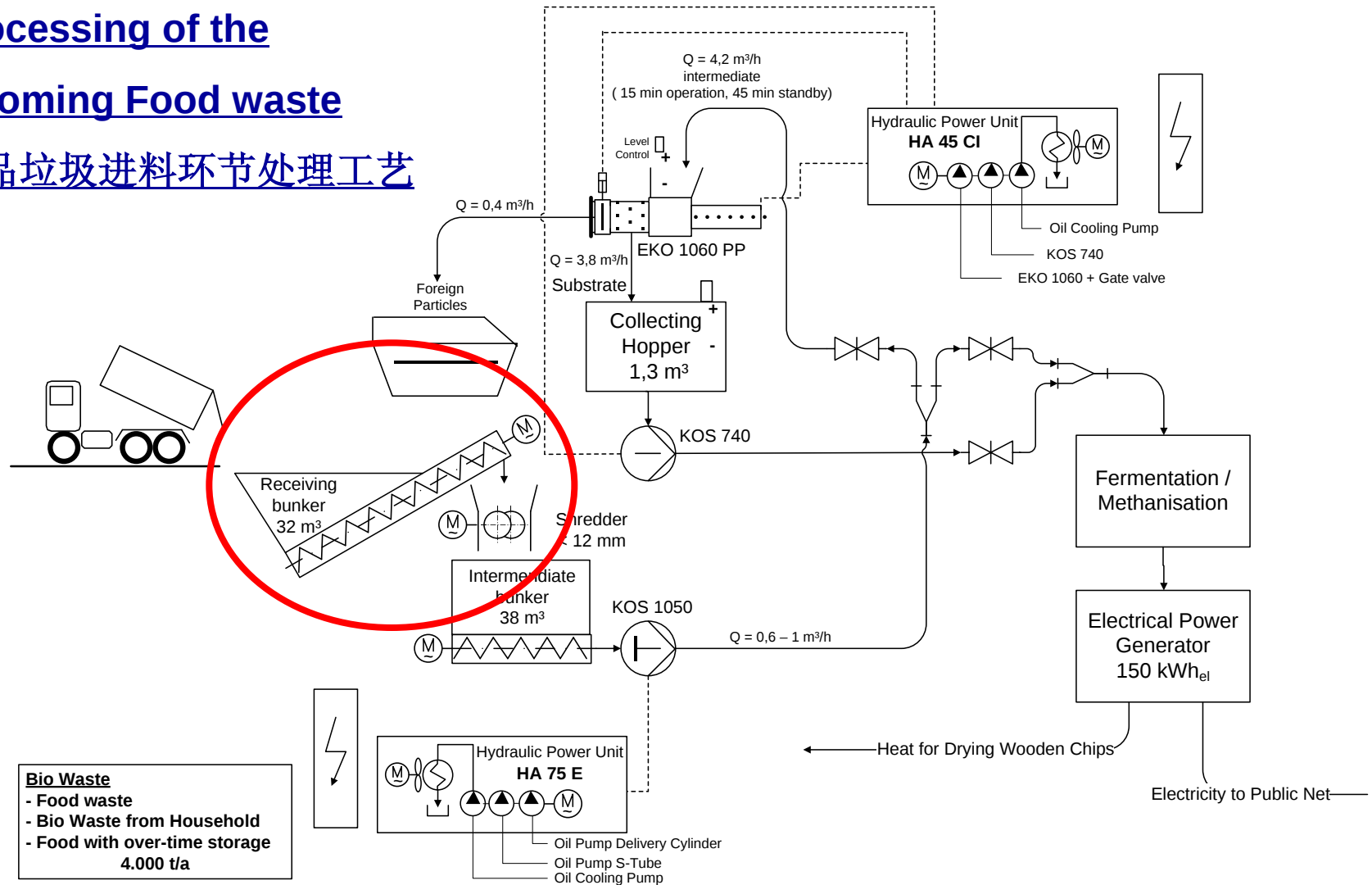
After the hydrolyses the material will be pump for separation of the packing material to a special single Piston pump
经过水解后，物料被泵送进入一个特殊的单柱塞泵用于分离包装物

The preparation of one (1) meal creates 100 g of Food Waste!

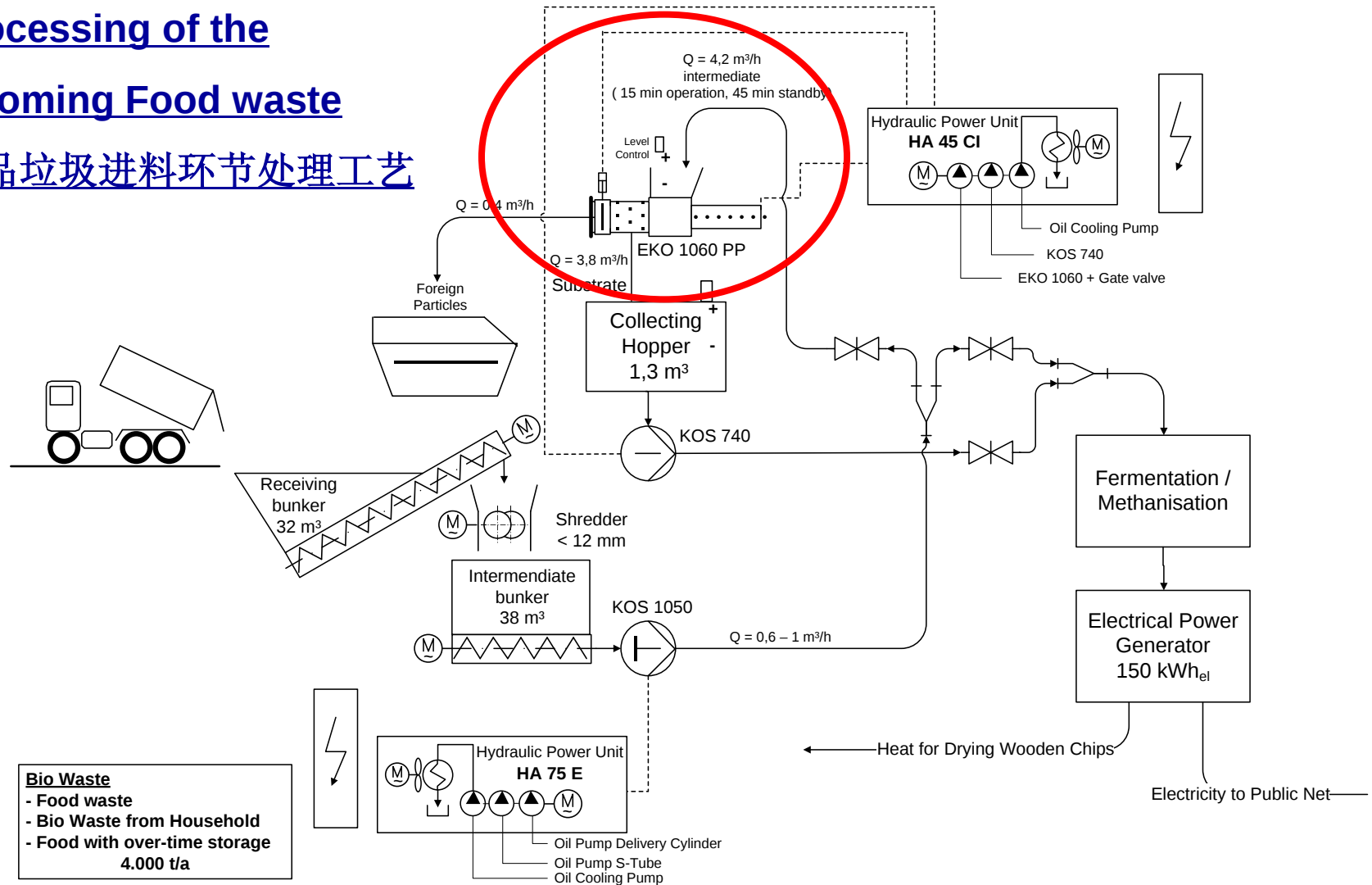
每顿饭将产生100g的食品垃圾

Processing of the Incoming Food waste

食品垃圾进料环节处理工艺



Processing of the Incoming Food waste 食品垃圾进料环节处理工艺

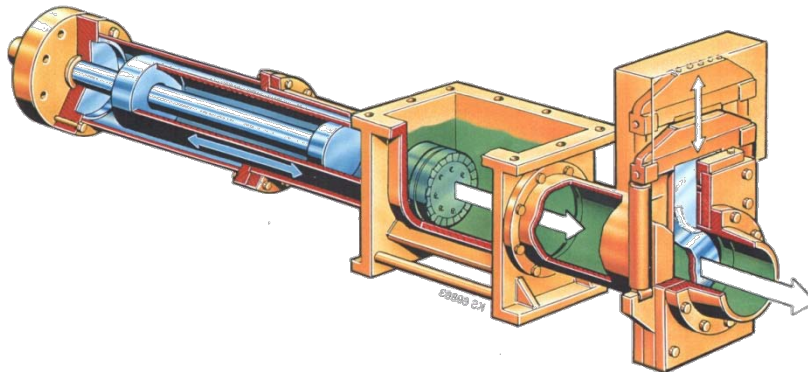




Material coming from the
hydrolyses tank
来自水解池的物料

Pipe line for the reject
杂物输送管道

Pipe line for the substrate
基质输送管道



This pump separating the
packing material from the
biogenic material in one
working step 该泵采用一步工
序将包装物和有机质成功分离

Food waste with expired storage time



OWS
DRANCO - Process

Valorga International
Valorga – Process

OWS / Belgium Dranco – Process 比利时OWS公司Dranco工艺 **19 Installation in 10 Countries 在10个国家有19处业绩**

Rome / I	Brecht I / B	Salzburg / A	Bassum / Ger	Leonberg / Ger
Alicante / ES	Brecht II / B	Pusan / Korea	Münster / Ger	Pohlsche Heide / Ger
Terrassa / ES	Idelux / B	Chablais / CH	Kempten / Ger	Leszno / PL
Vitoria / ES	Hotaks / J	Bourg-en-Bresse / F	Kaiserslautern / Ger	Wijster / NL

Valorga International Valorga – Process 法国Valorga工艺 **20 Installation in 10 Countries 在10个国家有20处业绩**

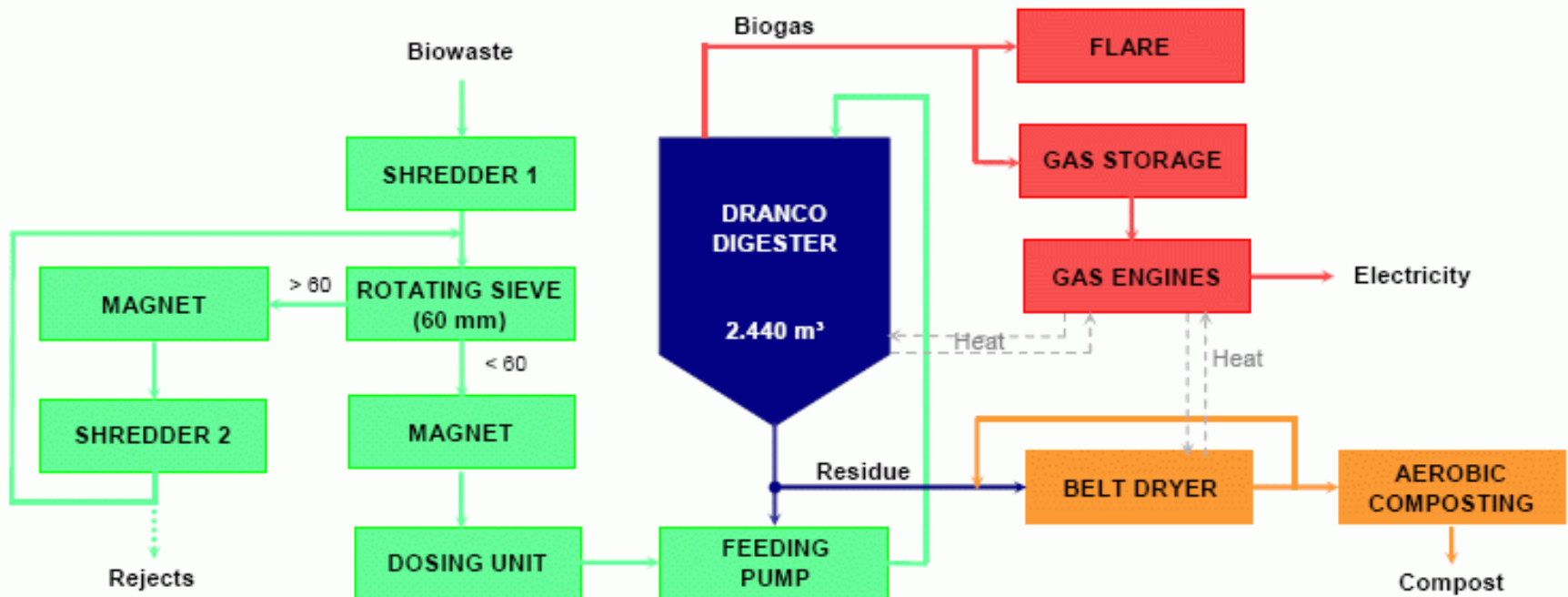
Amiens / F	Cadix / ES	Papethe / Tahiti	Genf / CH	Beijing / PRC
Calaise / F	Barcelona / ES	Tilburg / NL	Hannover / Ger	Schanghai / PRC
Varennes-Jarcy / F	La Coruna / ES	Tondela / P	Engelskirchen / Ger	Yingkou / PRC
Rounne / F	Mons / B	Tratolixo / P	Freiburg / Ger	Bassano / I

Dranco Process

www.ows.de

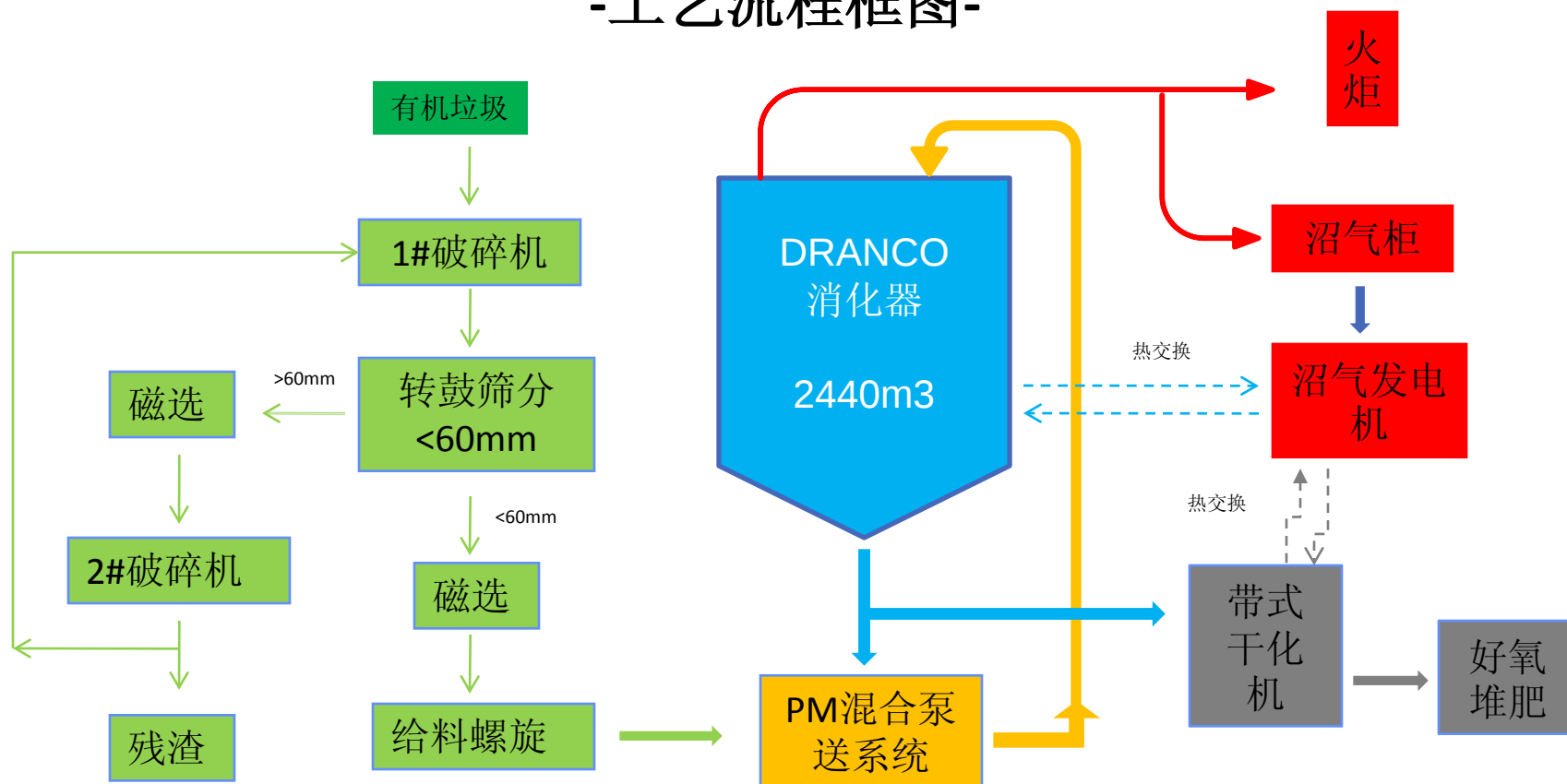


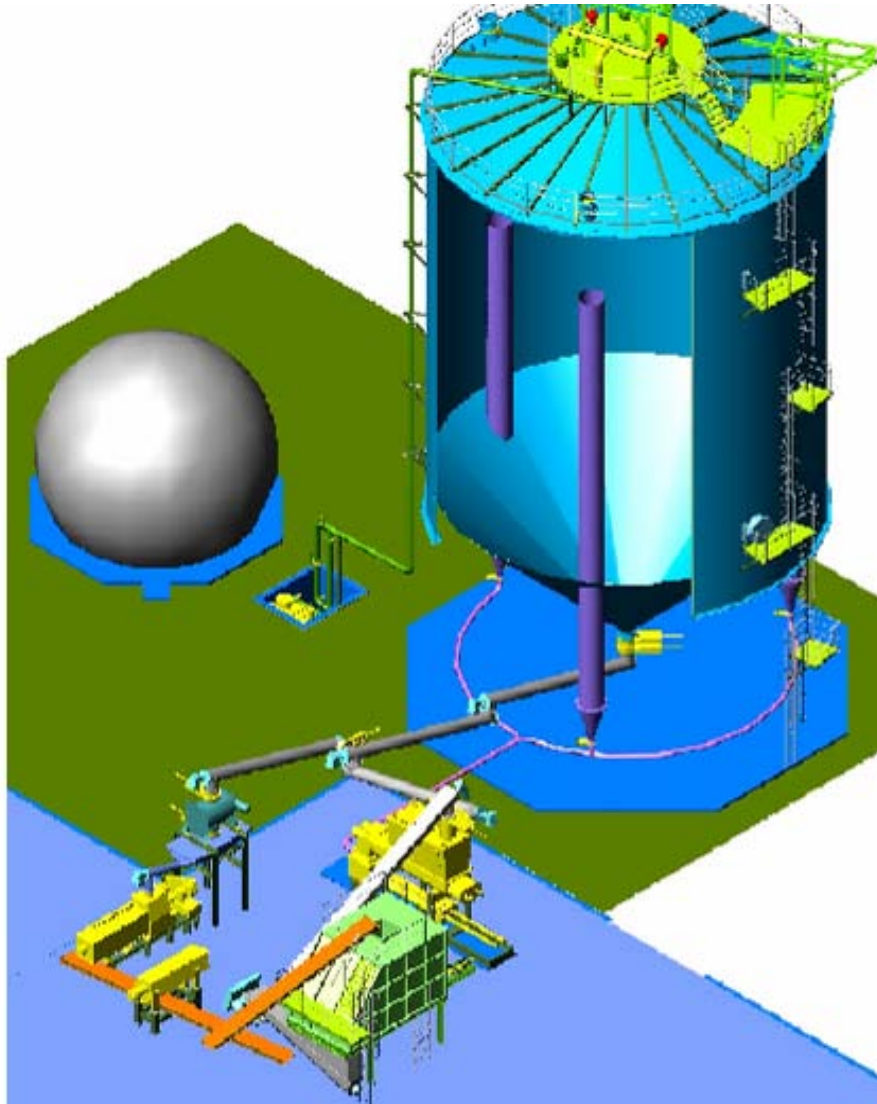
DRANCO plant Leonberg (Germany)



OWS的DRANCO工艺实例——位于德国斯图加特附近的LEONBERG 有机垃圾处理厂

-工艺流程框图-





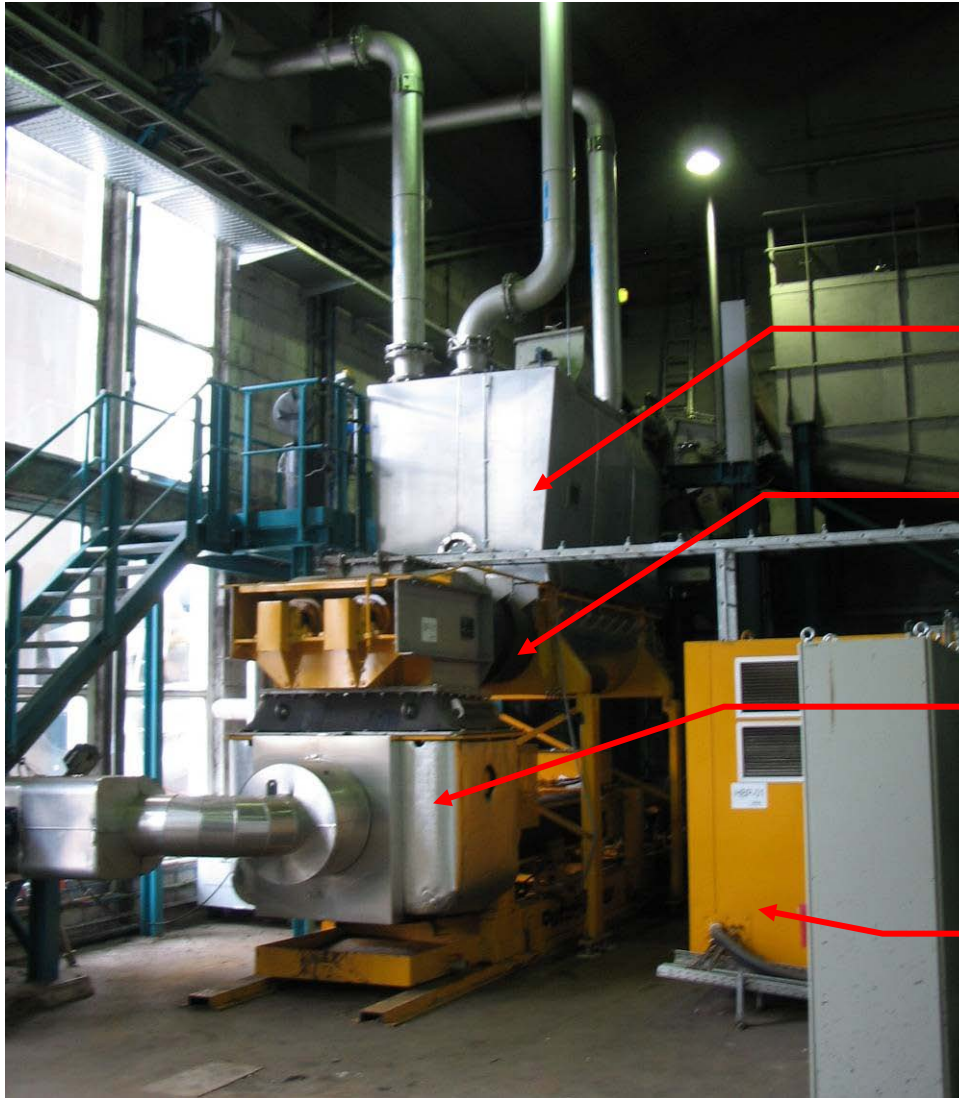
The DRANCO Process Characteristics 特点

- digester loading 消化负荷: 10 to 20 kg COD/m³ reactor per day
- temperature range 温度范围: thermophilic: 48 to 57° C (or mesophilic: 35 to 40° C)
- retention time in the digester 消化罐内停留时间: 15 to 30 days
- biogas production 沼气产率: 100 to 200 Nm³ of biogas per ton of waste
- electricity production 发电量: 220 to 440 kWh per ton of waste

Dranco Process

Putzmeister

Putzmeister Piston Pump at
the Dranco Plant Leonberg /
Germany 德国Leonberg项目



Collecting 手机料斗

Mixing Device 混合装置
(450 m³/h)

Piston Pump 柱塞泵
(150 m³/h; 10 bar)

Hydraulic Power Pack
液压站 (132 kW)

Typical Size of a OWS installation 以OWS典型项目举例

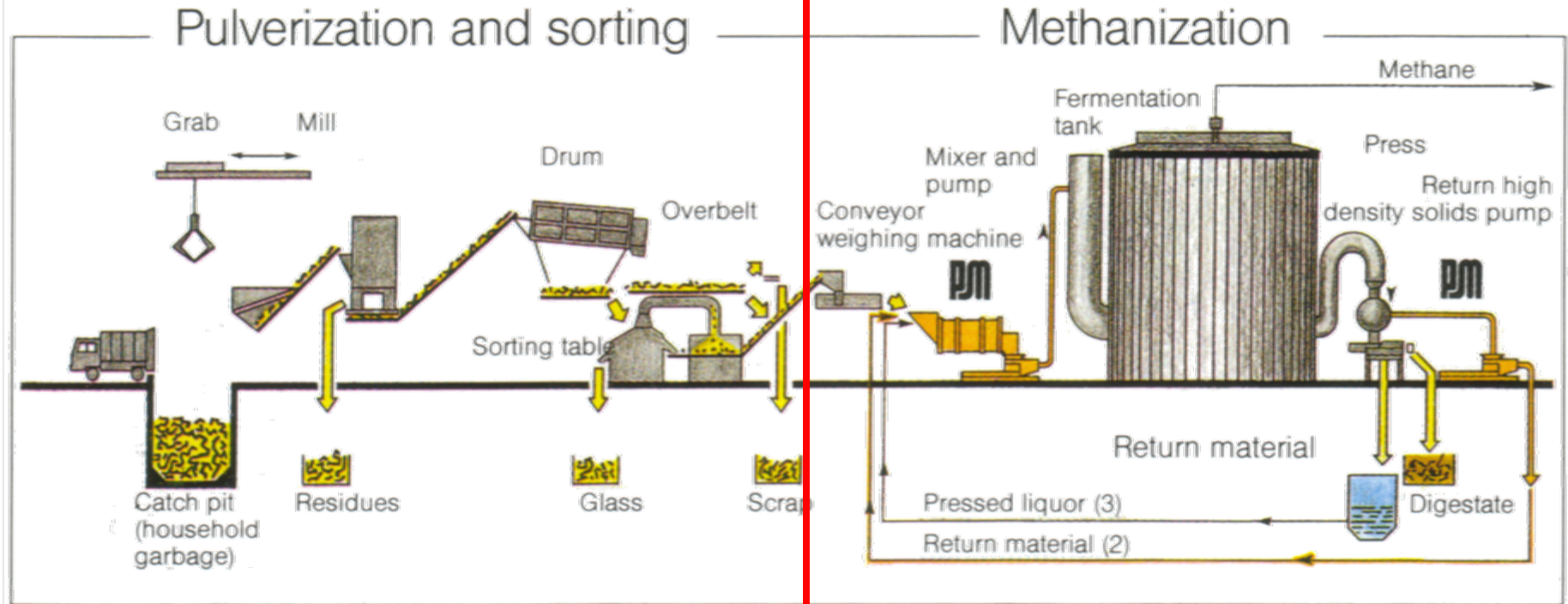
Location 位于:	Leonberg / Germany 德国斯图加特附近
Plant Capacity 规模:	30,000 t/a
Digestion capacity 设计:	30,000 t/a
Waste type 废物类型:	Biowaste 生物质
Reactor volume 反应罐:	2,440 m ³
Start-up 启动时间:	December 2004
Client 最终用户:	Abfallwirtschaft Landkreis Böblingen / Germany



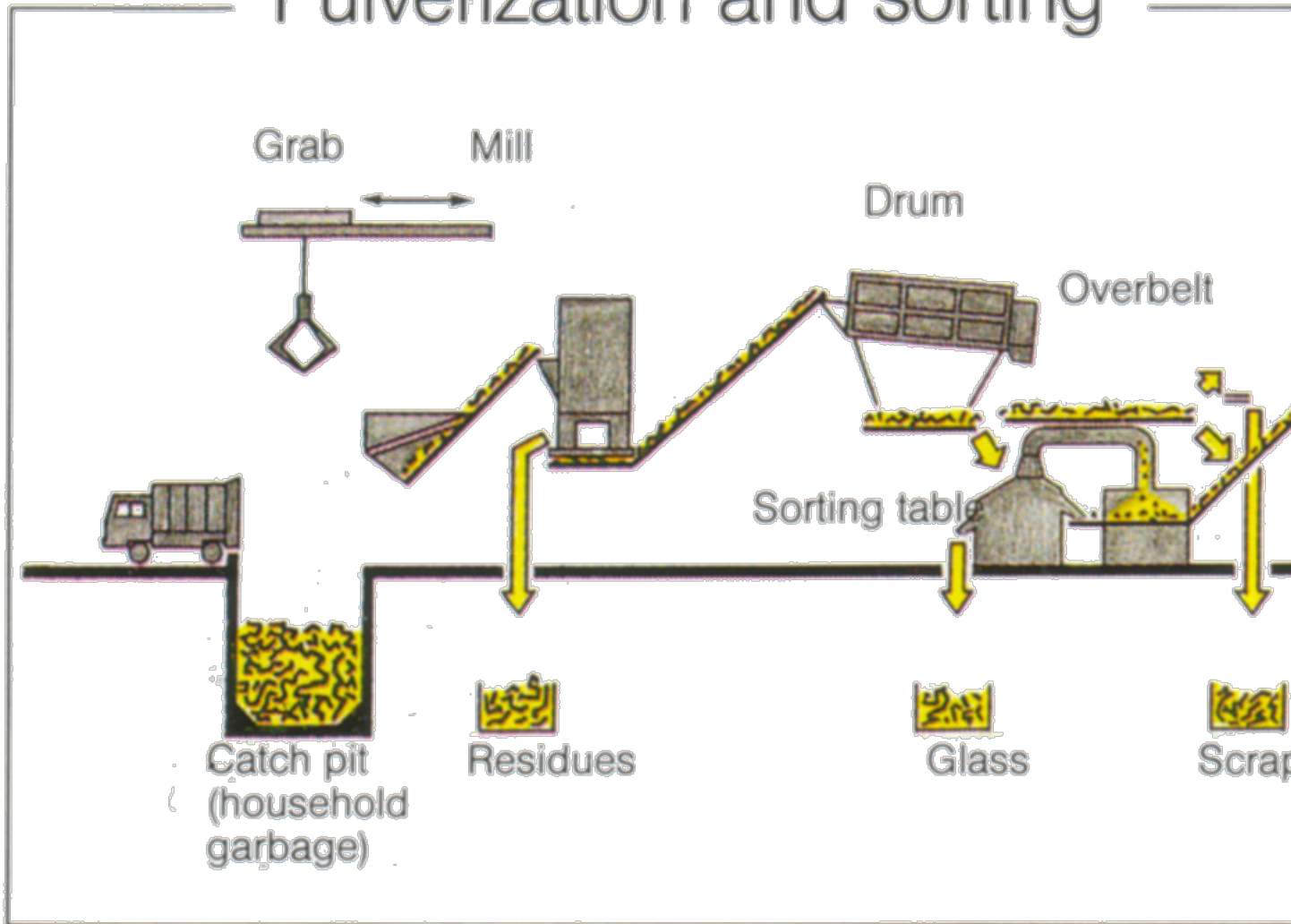
Valorga Process

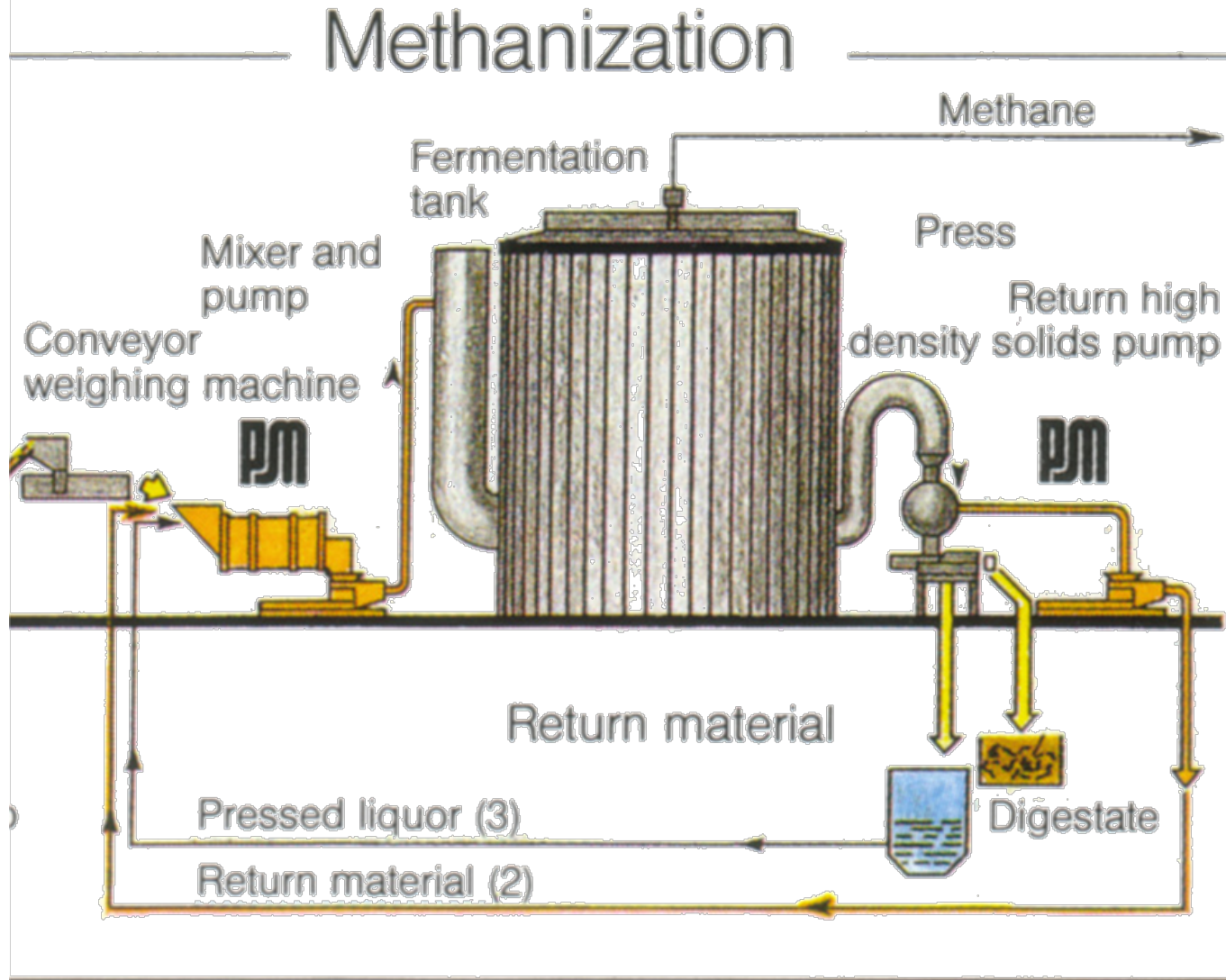
www.valorgainternational.fr





Pulverization and sorting





Valorga - Process

Putzmeister



Typical material for a Valorga installation. 典型的Valorga项目举例。

The material is collected household waste. 物料是收集到的生活垃圾。

Due to the fact that this material contain a lot of inorganic fractions the production of Methane Gas is lower as with pure organic material as for example food waste

因为物料中存在大量的无机物，所以其产气率低于纯粹的食品垃圾。

Valorga - Process

Putzmeister



Introduction pump with mixing auger and collecting hopper
带混合螺旋和料斗的进料泵单元

Feeding belt with fresh biomass
原生态有机质给料皮带

Collecting hopper
收集料斗

Mixing screw 混料器
(450 m³/h)

Return line of digested material
来自消化罐的沼液

Introduction piston pump
(150 m³/h, 10 bar)
给料柱塞泵

Typical size of a Valorga Process 典型的Valorga工艺案例

Location位于:	Hannover / Germany 德国汉诺威
Treatment capacity处理量:	100,000 t/a
Digester volume设计能力:	3 x 4,200 m ³
Retention time停留时间:	25 days
Specific methane yield甲烷产量:	90 Nm ³ /t input digestion
Biogas production产气量:	190 – 220 Nm ³ /t input digestion
Start-up启动时间:	2006



Biomethanisation plant “Terneuzen” in the Netherlands

Putzmeister



Biomethanisation plant “Terneuzen” in the Netherlands

Putzmeister



Input material
进泵原料

KOS 1480



KOS 1480



Biomethanisation plant “Terneuzen” in the Netherlands

Putzmeister



Using Animal Excrement as an Energy Source

使用动物粪便作为能源



Pumping Chicken Manure mixed with Corn and Wheat into Biogas Reactor

Putzmeister



Benefit of using Piston Pumps to feed Biomass into the fermentation for energy production 利用柱塞泵为作利用生物质进行发酵转化能源的进料装置的优点

- ✓ All different kinds of material with a certain organic content could be prepared and pumped. The material can be liquid as well as bulky
所有含有一定比例的有机物料均可被制备和泵送。无论是流动物料还是松散物料。
- ✓ With a piston pump it is possible to adjust the flow of material into the fermenter to have always the correct feed for the digesting process
使用柱塞泵进料，可对消化罐的入料量进行实时调节以适应消化工艺。
- ✓ Pipe line are hermetically closed and have no environmental impact of smell or leakage
管道完全密封，输送过程无异味，无泄漏，无环境二次污染

Benefit of using Piston Pumps to feed Biomass into the fermentation for energy production利用柱塞泵为作利用生物质进行发酵转化能源的进料装置的优点

- ✓ With the a single cylinder piston pump or a double cylinder piston pump it is possible to pump also material with a very percentage of dry solid and also containing large particles
使用单柱塞泵或双柱塞泵可满足高含固率和存在杂物时的工艺需求。

- ✓ With the special single cylinder piston pump it is possible to separate foreign particles from the material and guarantee a trouble free production of Methane gas in the fermenter

使用特殊的单柱塞泵可轻松分离生物质中的杂物，并且同时获得极其有利于后续消化工艺的基质。

- ✓ Due to the heavy duty design and the long experience with piston pumps equipment it is possible to operate the Bio Methanisation Process and the production of Energy at 24 h/d for years

得益于重负荷设计和长期经验，普茨迈斯特设备能满足全年满负荷生物质厌氧消化工艺的需求。

Thanks!

谢谢！

Putzmeister Solid Pumps GmbH

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<http://www.putzmeister-solid-pumps.de>; <http://www.psp-cn.com>;