



川源(中国)机械有限公司
GSD (China) Co., Ltd.

A photograph of an industrial facility with several large, vertical stainless steel tanks and complex piping systems under a clear blue sky. A walkway with railings is visible in the foreground on the right side.

FENTON

高效芬顿反应系统

Advanced FBR / FBC Reactor

高级氧化 • 深度处理 • 节能稳定

流体化床芬顿 (FBR-FENTON)深度处理氧化技术

FBR-FENTON: Advanced Oxidation Process



简介 Introduction

流体化床芬顿 (FBR-FENTON) 是利用流体化床的方式使芬顿法所产生的羟基氧化铁 (FeOOH) 以结晶或披覆在流体化床载体表面, 是一种结合了均相化学氧化 (H_2O_2/Fe^{2+})、异相化学氧化 ($H_2O_2/FeOOH$) 及流体化床结晶功能的新技术。本技术将传统的芬顿氧化反应器进行大幅度的改良, 可减少传统芬顿法产生的大量化学污泥; 在载体表面形成的羟基氧化铁具有异相催化的效果, 流体化床的操作方式可改善化学氧化反应及质传效率, 提高 COD 去除率。

FBR-FENTON using Fluidized-Bed Reactor (FBR) method makes the product, iron oxide (FeOOH), can crystallize or grow on the carrier surface, is a new technology, combining many interacting reactions like homogeneous catalysis (H_2O_2/Fe^{2+}), heterogeneous catalysis ($H_2O_2/FeOOH$) and FBR crystallization. This technology makes a significant improvement on traditional Fenton, therefore, large amount of chemical sludge can be reduced and the FeOOH which has heterogeneous catalysis ability will crystallize on the carrier surface simultaneously. The FBR operation also promotes chemical oxidation and mass transfer, enhancing the COD removal.

特点 Features

- 投资及运行成本低。
 - 停留时间短; 设备为高瘦型反应器, 可节约占地。
 - 可有效去除生物处理后难降解COD。
 - 可处理废水类型广泛。
 - 与传统芬顿相较, 可有效降低70%污泥量, 节约成本。
- Low investment and operating costs.
 - Shorten retention time; reactors are constructed in a tall slender shape, saving the required space.
 - Can effectively degradate refractory or residual COD.
 - Multiple types wastewater can be treated.
 - In comparison with traditional Fenton methods, FBR-Fenton can effectively reduce 70% sludge production and cost savings.



应用 Applications (COD < 500 mg/L)

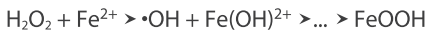
- 浆纸业废水
- 化工业废水
- 垃圾渗滤液
- 皮革业废水
- 印染业废水
- 金属表面处理业废水
- 电镀业废水
- Pulp and paper wastewater
- Chemical industry wastewater
- Landfill leachate
- Leather wastewater
- Printing and dyeing wastewater
- Metal surface treatment wastewater
- Electroplating wastewater



原理及工艺流程 Principle and technique process

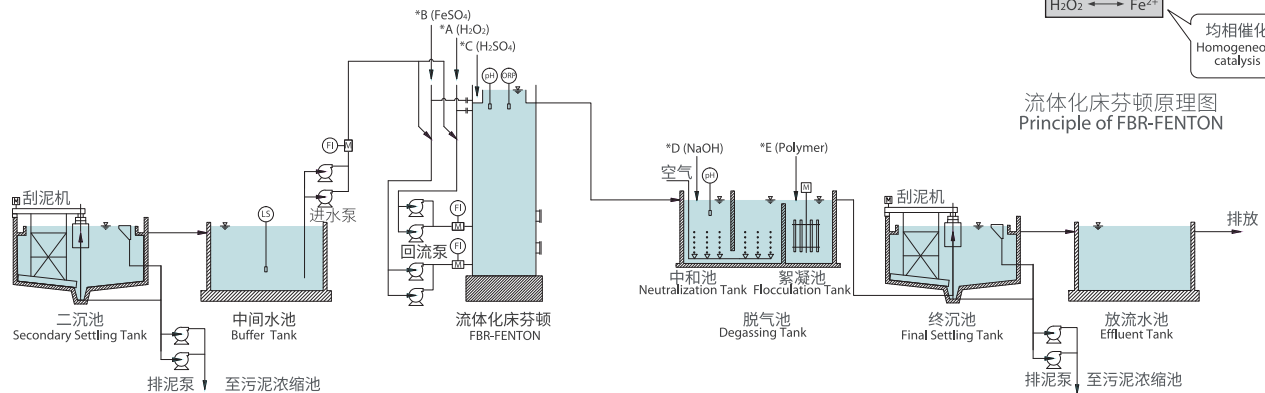
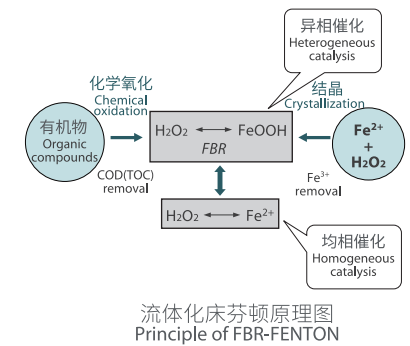
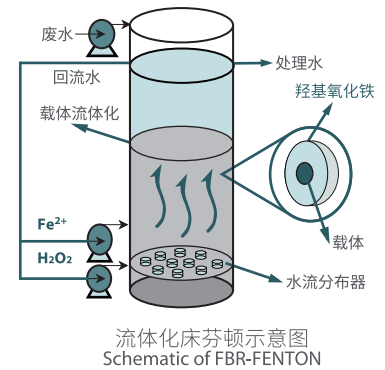
■ FBR-FENTON 氧化原理：藉由均相亚铁离子 (Fe²⁺) 及异相羟基氧化铁 (FeOOH) 二种催化方式，催化过氧化氢 (H₂O₂) 产生羟基自由基 (·OH)，并进一步将有机物降解。生成的FeOOH同时具有催化H₂O₂的功能，并可作为流体化床结晶的载体，由Fenton 反应产生的三价铁离子 (Fe³⁺) 会附着于载体表面上 形成结晶，并减少 Fe(OH)₃沉淀，因此可有效减少污泥量。

■ FBR-FENTON 的反应式：



■ The principle: There are two catalysts in the fluidized-bed reactor. Fe²⁺ is the homogeneous catalyst and FeOOH is the heterogeneous catalyst of H₂O₂ to oxidize organic compounds. The supported FeOOH crystals act as both catalysts of H₂O₂ and carriers of FBR for crystallization. The iron product of Fenton's reaction can crystallize and grow on the carrier surface to reduce the precipitation of Fe(OH)₃, therefore, the sludge can reduce effectively.

■ Reaction equation of FBR-FENTON:



流体化床芬顿实绩 References

湖州德清新市污水厂	远东纺织(越南)有限公司	山东太阳纸业股份有限公司
长春化工(漳州)有限公司	日照华泰纸业	福建泰庆皮革有限公司
上实联熹水务有限公司	长春化工(江苏)有限公司	四川华侨凤凰纸业有限公司
永丰余工业用纸股份有限公司	正隆平阳造纸责任有限公司	石嘴山经济开发区东区污水处理厂
联合环境海门污水处理厂	长兴化学工业股份有限公司(屏南厂)	台州化学原料药产业园区临海区块污水处理厂
宝钢湛江钢铁有限公司	台耀化学股份有限公司	永丰余造纸(扬州)有限公司
路易达孚中奥能源工程	长春化工(盘锦)有限公司	山东亚太森博浆纸有限公司
韶能集团股份有限公司珠玑纸业分公司	远通纸业(山东)股份有限公司	广东鼎丰纸业(股)公司
南帝化学工业股份有限公司林园厂	安徽华泰林浆纸有限公司	无锡荣成纸业
广东银洲湖纸业	宁波亚洲浆纸业有限公司	安琪酵母新疆公司
海南金海浆纸业有限公司	重庆理文造纸有限公司	镇江国亨化工股份有限公司
台化股份有限公司宁波厂	广东鼎丰纸业股份有限公司	宝泰鞋材厂

流体化床结晶 (FBC) 技术

FBC: Fluidized Bed Crystallizer Technology



简介 Introduction

流体化床结晶 (Fluidized Bed Crystallizer, FBC) 技术是利用其他盐类 (如碳酸盐、磷酸盐、草酸、氟化物或硫化物等) 达到共低溶解度及稳态晶体的特性, 使晶体在流体化床中的载体上成长, 以去除废水中的阳离子 (如金属离子) 及阴离子 (如磷酸根离子)。结晶技术采用 0.2-0.5 mm 硅砂载体在结晶槽中作为结晶核种, 欲处理之废水及添加药剂系由该反应槽之底部进入并向上流动, 而该反应槽外接有一回流水管路, 用以调整进流水过饱和度及达到载体上流速度, 使欲处理的无机离子于硅砂载体表面形成稳态结晶体, 当晶体粒径达 1-2 mm 后, 排出槽外进行回收再利用或达废弃物减量、处置的目的。

Fluidized Bed Crystallizer (FBC) is application of salts such as carbonate, phosphate, oxalate, fluoride or sulfide to achieve common-ion effect and steady state crystal condition, and then to make crystal grow on surface of carriers in fluidized bed reactor, to remove wastewater cations (such as metal ions) and anions (such as phosphate ions) through this method.

This technology uses 0.2-0.5 mm silica sand carriers in reactor as nucleus, wastewater and additives are entered from the bottom of reactor and flow upward. Moreover, the reactor is connected with a recirculation water pipeline to adjust the inlet water supersaturation and reach the carriers' up-flow velocity, so that inorganic ion forms a stable crystal at the surface of silica sand carriers. When crystals grow up to 1-2 mm, discharging the crystals from reactor for reuse or achieving waste reduction.

特点 Features

- 初设成本低。
- 操作成本低。
- 废弃物减量或资源化。
- 由于担体流体化效率高, 增加反应速率, 因此可以节省槽体体积及所需土地面积。
- 反应后的晶体含水率较沉淀处理程序的污泥含水率低很多, 若晶体可回用更可达到废弃物资源化的目的; 若不能回用, 亦能达到污泥减量 (至少 75%) 的目的。
- 利用自动控制程序调整药剂的加药量, 使系统内维持结晶的最佳条件, 达到最低加药成本及最佳的结晶率。
- Low initial cost.
- Low operating costs.
- Waste reduction or reuse.
- It can save reactor volume and required land area due to high fluidization efficiency and increased reaction rate.
- The water content of crystals is much lower than sludge. Crystal can achieve the purpose of waste recycling, if not, it still can achieve sludge reduction (at least 75%).
- Using automatic control of dosing system to make the reactor maintain in best conditions for crystallization, achieving minimum cost of dosing and best crystallization rate.

应用

- 重金属的去除与回收
- 磷酸盐的去除
- 氟化物的去除
- 硬水软化
- Removal and recovery of heavy metals
- Phosphate removal
- Fluoride removal
- Water softening



原理及工艺流程 Principle and technique process

■ 流化床现象

当流体由下往上通过固体颗粒层时，在流体的作用下，固体颗粒层呈现类似流体行为的现象，称之为流化化(fluidization)，而流化床，即指具流体行为之固体颗粒层。流化床技术其应用在结晶技术的主要特性为能提供较大的比表面积及属于柱塞状流动，因此反应速率较快且处理效果佳。

■ 结晶与沉淀

结晶主要的机制有二：成核及成长。当操作条件控制不当或反应槽设计不良，尤其是反应槽底部过饱和度太高时，极易产生初成核现象，即一般所谓的沉淀而非结晶，此时出流水由于悬浮固体增加而有明显的混浊现象。

■ Fluidized Bed Phenomenon

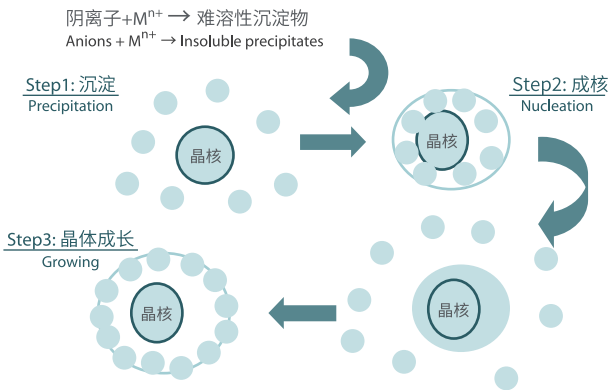
When fluid upward passes through a solid particle layer, this layer appears a fluid-like behavior known as fluidization; while a fluidized bed, that is a solid particle layer which occurs fluidization.

Fluidized bed, applied in the crystallization technology, can provide a larger surface area. And reactor condition is like plug-flow state. Therefore, the reaction rate is faster and treatment effect is improved.

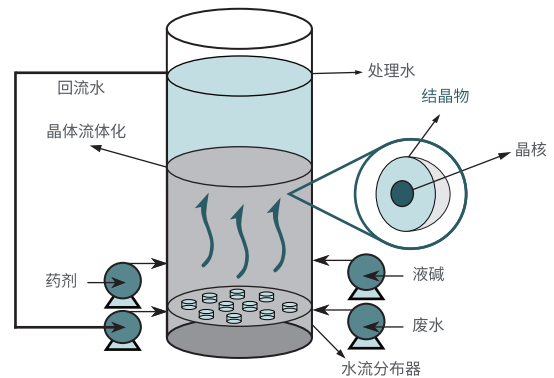
■ Crystallization and Precipitation

The main mechanism of crystallization: nucleation and growth.

when operation condition is at improper control or the reactor has poor designs, especially supersaturation of the reactor bottom is too high, easily occurring to precipitation rather than crystallization. The effluent at this time has obvious turbidity due to increase of suspended solids.



流化床结晶原理图
Principle of FBC

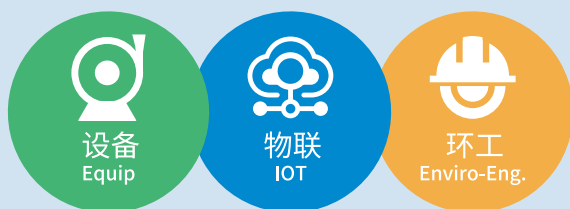


流化床结晶示意图
Schematic of FBC

流化床结晶实绩 References

亚东石化股份有限公司	奇美电子股份有限公司	自来水公司荻桐净水场
包钢华美稀土高科有限公司	中华映管股份有限公司	广辉电子股份有限公司
Micron Semiconductor Asia Pte. Ltd.	硅格电子股份有限公司	

致力于以精良的设备系统、精湛的节能环保技术、人工智能和物联网技术，帮助更多的客户创造更大价值。



水处理系统专业合作伙伴

免费咨询电话

400-657-9066

本型录内容如有变更，恕不另行通知。
We reserve the right to change content without notice.

川源（中国）机械有限公司版权所有 all rights reserved. CY-35

