

## 服务优势

Advantages

### 全链条服务体系，一站式交付

覆盖顶层决策、工艺研发、自动化建设、工程实施、质量合规到项目管控的完整体系，提供项目全生命周期咨询、设计、交付、验证与运维一站式服务。

#### Full-Chain Service System – One-Stop Delivery

Covering the complete framework from top-level decision-making, process R&D, automation construction, engineering implementation, quality compliance, to project management and control, providing one-stop services for consulting, design, delivery, validation, and O&M throughout the entire project lifecycle.

01

### 懂发酵工艺+懂AI算法+懂工业软件

深耕发酵行业多年，团队兼具生物工程背景与 AI 算法、工业软件全栈开发能力，深谙生产工艺与核心痛点，实现从架构设计、数据采集到验证交付的全链路技术闭环。

#### Deep Expertise in Fermentation Process + AI Algorithms + Industrial Software

With years of deep cultivation in the fermentation industry, our team possesses combined expertise in bioengineering, AI algorithms, and full-stack industrial software development. We have in-depth knowledge of production processes and core pain points, enabling a full-chain technical closed loop from architecture design and data acquisition to validation and delivery.

02

03

### 自主知识产权，核心技术可控

拥有从数据处理、AI 算法到业务应用的全链条核心专利与软件著作权，涵盖多菌种发酵自动化系统、产物浓度实时检测算法、偏差预警与工艺优化方法等，技术自主可控，不受外部制约。

#### Independent Intellectual Property – Core Technologies Under Control

Holding core patents and software copyrights across the entire chain from data processing and AI algorithms to business applications, covering multi-species fermentation automation systems, real-time product concentration detection algorithms, deviation warning and process optimization methods, etc. Our technologies are independently controllable and free from external constraints.

### 安全可靠，合规保障

“传输 + 存储 + 内存”三级加密体系，支持全栈私有化部署，核心数据存储于企业内网；承诺 99.9% 系统可用性，配备多种灾备机制。已通过等保三级及 ISO 27001 认证，符合生物发酵行业智控标准。

#### Secure, Reliable, and Fully Compliant

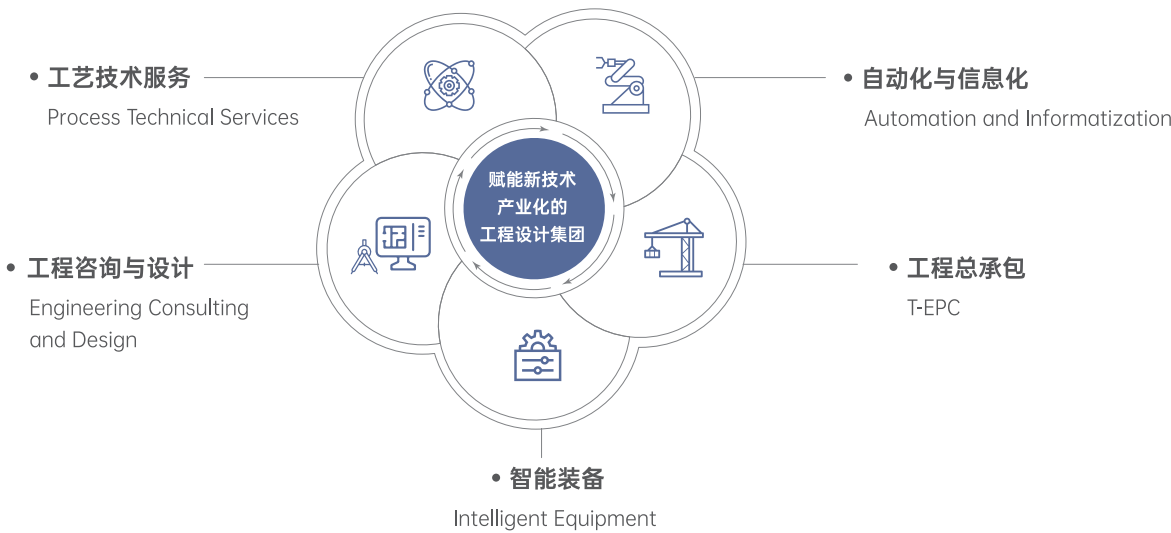
Three-tier encryption system covering "transmission + storage + memory," supporting full-stack on-premise deployment with core data stored within the enterprise intranet. Committed to 99.9% system availability with multiple disaster recovery mechanisms. Certified with Class 3 Level Protection and ISO 27001, fully compliant with intelligent control standards for the bio-fermentation industry.

## 天俱时集团

TIANS Group

天俱时集团是赋能新技术产业化的工程设计集团，以“天俱时模式”重新定义工程交付标准。我们以“Tech the Future”为品牌理念，提供集技术研发、工程咨询与设计、工程总承包、智能装备、自动化与信息化于一体的综合解决方案，精准助力客户实现从实验室到工厂（From Lab to Fab）的产业化飞跃。业务深度聚焦精细化工、含氟精细化学品、电子化学品、电子特气、合成生物、生物发酵、生物医药、化学制药、食品健康等前沿高科技领域。

TIANS Group is an engineering design group enabling the industrialization of new technologies, redefining engineering delivery standards through its "TIANS Model". With the brand philosophy of "Tech the Future", we provide integrated solutions encompassing technology R&D, engineering consulting & design, EPC contracting, intelligent equipment, automation and informatization, precisely assisting clients in achieving industrial leaps from lab to fab (From Lab to Fab). Our business focuses on cutting-edge high-tech sectors including fine chemicals, fluorine-containing fine chemicals, electronic chemicals, electronic specialty gases, synthetic biology, bio-fermentation, bio-pharmaceuticals, chemical pharmaceuticals, and food health.



天俱时工程科技集团有限公司

中国·河北·石家庄市裕华东路530号天山科技工业园A座

400-082-6116

TIANS ENGINEERING TECHNOLOGY GROUP CO., LTD.

BUILDING A, TIANSHAN SCIENCE AND TECHNOLOGY INDUSTRIAL PARK, NO. 530, YUHUA EAST ROAD, SHIJIAZHUANG, HEBEI, CHINA



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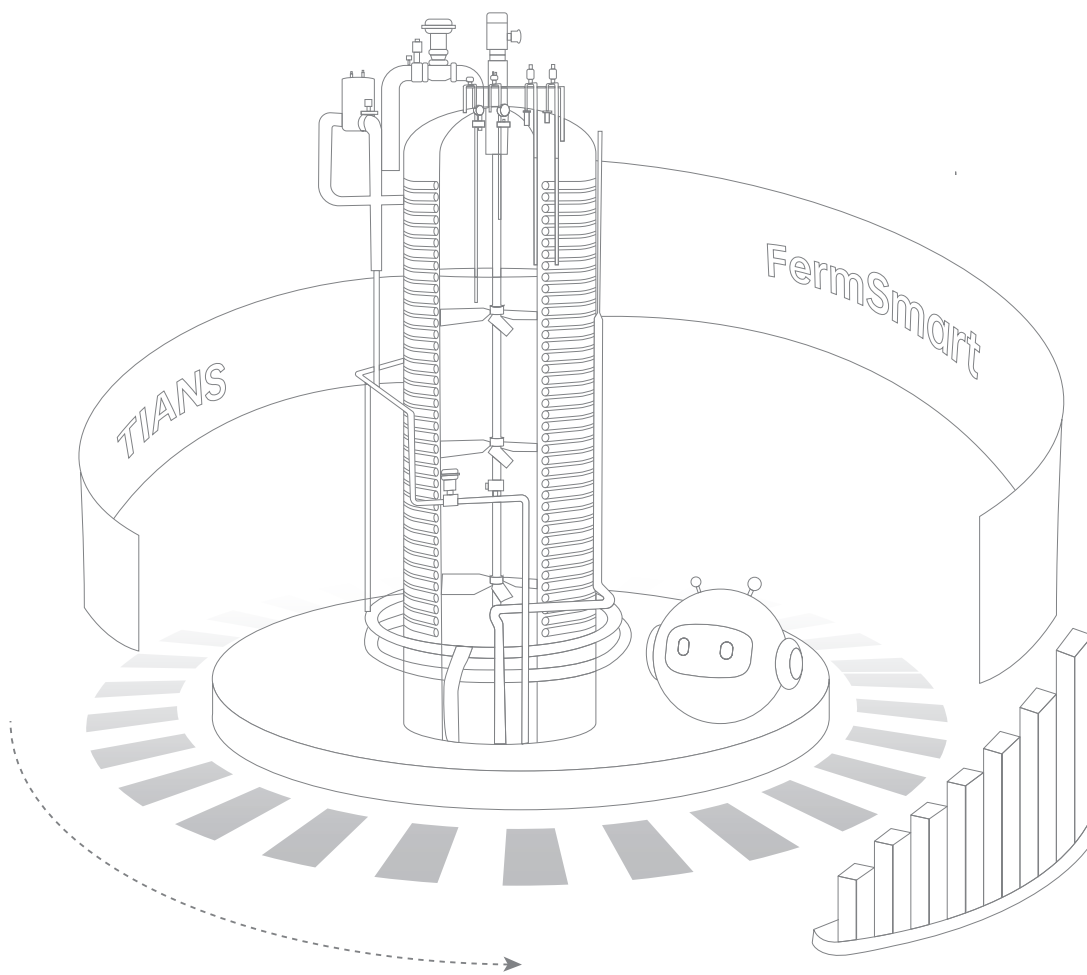
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TIAN'S 天俱时

## FERMSMART™ AI FERMENTATION ANALYSIS SYSTEM

### FermSmart™ 发酵生产AI分析系统



### 让每一批生产，都是“黄金批次”

ENSURING THAT EVERY BATCH IS A "GOLDEN BATCH"

## 系统简介

Introduction

生物发酵是“看不清、控不准、复制难”的复杂生化过程，受温度、pH、溶氧、补料等多因素交互影响，具有多变量、强耦合、非线性、大时滞特征。国内主流企业虽在配料、灭菌、培养、放罐等环节实现了自动化，但生产管理、工艺优化、质量管控仍依赖人工和经验，严重制约了生产效率、收率和质量稳定性。

天俱时 FermSmart™ 发酵生产AI分析系统深度融合大数据、工业AI算法与多源异构数据治理与分析技术，打破发酵生产DCS实时控制数据、实验室化验数据、物料仓储质检数据的数据孤岛。深度分析并实现基于规则和算法的双通路控制模型，实现发酵生产全链路数据的精细化管理，优化工艺参数、减少批间差异、节约能耗、降低生产成本，让每一批生产，都是“黄金批次”。

Fermentation is a complex bioprocess — hard to monitor, control, and replicate — driven by the interplay of temperature, pH, DO, and feed rates, with multivariable coupling, strong nonlinearity, and large time delays. While media preparation, sterilization, cultivation, and harvest are automated, production management, process optimization, and quality control still rely on manual experience, limiting efficiency, yield, and consistency.

TIANS FermSmart™ fuses big data, industrial AI, and multi source data governance to bridge the silos between real time DCS control, laboratory testing, and warehouse quality data. Its dual pathway control model — combining rule based logic and algorithmic optimization — enables full chain digital precision. Optimize parameters, Reduce batch variation. Cut energy and costs. Ensuring that every batch is a "Golden Batch".



### 1 提高单罐产量

Boost per-batch yield

通过工艺优化，显著提升目标产物的产量，降低杂质水平。  
Optimize the process to significantly increase target product output and reduce impurity levels.

### 2 降低生产成本

Cut production costs

减少原料及能耗浪费，降低能批批及工厂总体生产成本。  
Reduce raw material and energy waste, lowering both per-batch and overall plant production costs.

### 3 减少批间差异

Minimize batch-to-batch variation

稳定发酵过程，确保批次间产品质量的一致性。  
Stabilize the fermentation process to ensure consistent product quality across batches.

### 4 获取最佳发酵周期

Pinpoint the optimal harvest window

预测后期发酵指标趋势，从产量和成本的综合角度获取最佳放罐周期。  
Predict late-stage indicator trends and determine the ideal harvest timing based on a balance of yield and cost.



## 解决方案

### Solution

#### CHALLENGE

##### 痛点

#### 生产高度依赖人工经验, 产品批次稳定性差

发酵过程深度依赖人工, 导致各生产批次间产品质量波动大、一次合格率不稳定、优质批次无法复刻。

Production is highly dependent on manual experience, resulting in poor batch-to-batch stability.

The fermentation process relies heavily on manual operations, leading to significant quality fluctuations between production batches, unstable first-pass yield rates, and an inability to replicate high-quality batches.

#### 多源数据割裂, 数据孤岛问题突出

核心数据体系, 与 ERP、MES 执行跟踪等业务系统相互独立、数据标准不统一、无法互联互通, 工艺人员难以快速获取全局关联信息。

Fragmented multi-source data and prominent data silos.

Core data systems operate independently from business systems such as ERP and MES execution tracking, with inconsistent data standards and a lack of interoperability, making it difficult for process engineers to quickly access globally correlated information.

#### 生产过程黑盒化, 工艺反馈严重滞后

无法实时检测发酵核心指标 (菌浓、效价、还糖、氨基氮等), 离线化验数据滞后数小时至半天, 工艺人员无法及时感知偏差并调整策略。

Black-box production process with severely delayed process feedback.

Inability to monitor core fermentation indicators (cell concentration, potency, residual sugar, amino nitrogen, etc.) in real time, with offline laboratory data lagging by several hours to half a day, preventing process engineers from promptly detecting deviations and adjusting strategies.

#### 工艺分析低效, 过程无智能自控

人工比对数据耗时、分析维度不足, 难挖掘参数关联, 不利于优化决策; 关键参数依靠人工经验, 响应滞后、批次一致性差。

Inefficient process analysis and a lack of intelligent automatic control. Manual data comparison is time-consuming and limited in analytical dimensions, making it difficult to uncover parameter correlations and hindering optimization decisions; key parameters rely on manual experience, resulting in delayed responses and poor batch-to-batch consistency.

#### SOLUTION

##### 解决方案

#### 黄金批次工艺轨迹对标与复刻

实时获取历史最优批次, 波动率降低 10%+, 产能提升 5%+, 黄金批次工艺可复制推广。

Golden batch process trajectory benchmarking and replication.

Real-time retrieval of historical optimal batches, reducing batch-to-batch variability by 10%+, increasing production capacity by 5%+, and enabling the replication and promotion of golden batch processes.

#### 全链条追溯, 构建多元发酵数据库

构建以发酵批次为线索的关联信息体系, 破除多系统数据割裂难题, 实现全流程数据互通可追溯, 为工艺对标分析提供完整数据支撑。

Full-chain traceability with the construction of a multi-dimensional fermentation database.

Build a batch-centric, correlated data framework that breaks down silos across systems—enabling end-to-end data connectivity and traceability, and providing a complete data foundation for process benchmarking.

#### 核心指标、关键参数趋势实时监测

实现发酵工况动态感知, 解决离线化验数据滞后痛点, 及时发现工艺偏离, 消除生产过程黑箱, 保障生产稳定运行。

Real-time monitoring of core indicators and key parameter trends.

Achieve real-time visibility into fermentation conditions, eliminate the pain point of delayed offline lab data, catch process deviations early, remove the black box from production, and ensure stable operations.

#### 秒级输出工艺洞察, 规则引擎智能自控

搭载 AI 多维分析 + RAG 自然语言问答, 内置 LLM 自动解读分析报表; 规则引擎智能自控, 自动精准调控温度、pH、溶氧、补料等全维度参数。

Second-level process insights delivery with rule-engine intelligent automatic control.

Equipped with AI multi-dimensional analysis + RAG natural language Q&A, with built-in LLM for automatic interpretation of analytical reports; rule-engine intelligent automatic control enables precise and automatic regulation of full-dimensional parameters including temperature, pH, dissolved oxygen, and feeding.

## 功能亮点

### Key Features

#### 01 全数据打通, 建立黄金批次基准库

Full data integration to establish a golden batch benchmark library.

打通 DCS 控制实时数据、实验室化验数据、物料仓储质检数据、MES、ERP 等系统数据, 以发酵批次为唯一核心构建统一数据库, 所有工艺参数、物料、检测数据同源可追溯, 沉淀企业自有黄金批次标准工艺库。

Unify real-time DCS data, lab testing data, warehouse quality data, MES, ERP, and more — centered on each fermentation batch — into a single, traceable database. Every process parameter, material, and QC record is fully traceable to one source, building your proprietary Golden Batch process library.

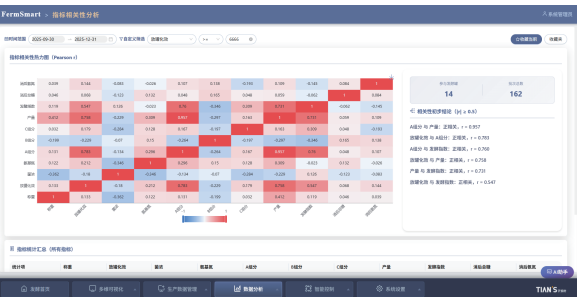


#### 02 AI 多维分析, 自动识别、复刻黄金批次

AI multi-dimensional analysis for automatic identification and replication of golden batches.

自动按产量、效价、转化率加权筛选黄金批次, 提取完整工艺轨迹;  
Automatically screen golden batches through weighted scoring based on yield, potency, and conversion rate, and extract complete process trajectories.

多批次交叉对比分析, AI 自动挖掘参数与产物产量的关联规律, 数天人工复盘压缩至小时级;  
Conduct cross-comparison analysis across multiple batches, with AI automatically mining correlations between parameters and product yield, compressing days of manual review into hours.

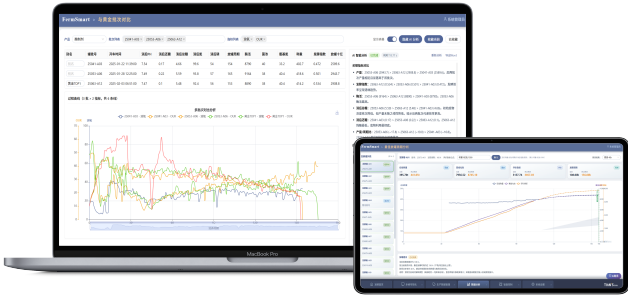


#### 03 实时透明化发酵过程, 及时纠偏不偏离黄金轨迹

Real-time transparent fermentation process with timely deviation correction to stay on the golden trajectory.

搭载拉曼、近红外在线光谱传感器, 搭配本地 AI 预测模型, 分钟级实时输出菌浓、效价、残糖、氨基氮等核心指标, 彻底消除半天级数据滞后; 实时对标黄金批次工艺曲线, 参数偏离自动预警, 全程贴合最优工艺轨迹。

Equipped with Raman and NIR online spectroscopic sensors, paired with on-premise AI prediction models, to output core indicators such as cell concentration, potency, residual sugar, and amino nitrogen in real time at minute-level intervals, completely eliminating half-day data lags. Real-time benchmarking against golden batch process curves with automatic alerts for parameter deviations, ensuring full-process alignment with the optimal process trajectory.

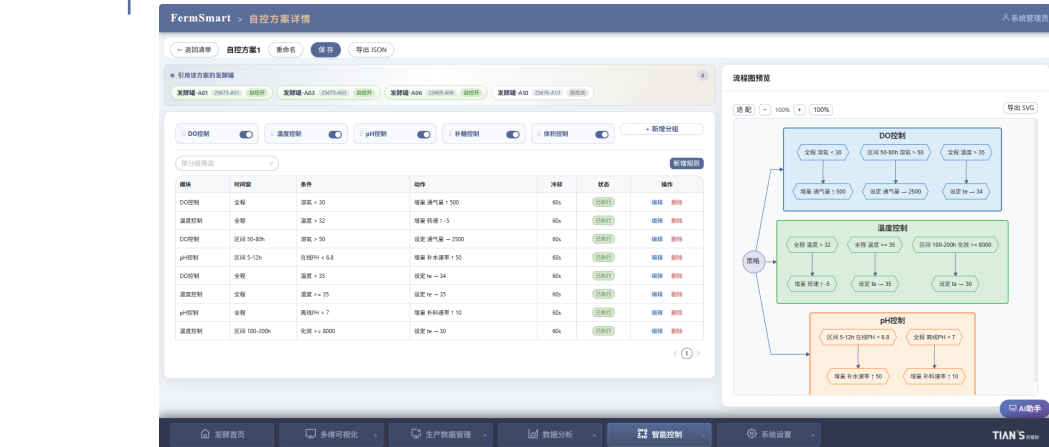


#### 04 智能自控, 全程守住黄金工艺标准

Intelligent automatic control to maintain golden process standards throughout.

内置规则引擎 + 多类发酵 AI 模型, 温度、pH、溶氧、补料等参数全自动调控, 实时预测终产量、提前预警染菌, 综合产量、成本智能推荐最优放罐周期, 全程日志留痕, 无需人工值守也能稳定跑出黄金批次。

Built-in rule engine + fermentation AI models enable fully automatic regulation of temperature, pH, dissolved oxygen, and feeding. Real-time yield prediction and contamination early warning. Intelligent recommendation of optimal harvest timing based on yield and cost. Full traceability ensures stable golden batch production even without manual intervention.



AI 模型  
AI Models



全自动调控  
Auto-Regulation



实时预测  
Real-time Prediction



智能推荐  
Smart Suggestion



全程留痕  
Full Traceability

#### 05 AI 智能问答, 快速沉淀黄金工艺经验

AI Q&A for rapid accumulation of golden process experience.

本地 LLM+RAG 工艺知识库, 自然语言一键查询批次数据; 所有分析页面自动生成 AI 工艺解读, 输出优化建议, 黄金批次工艺经验数字化留存, 新人快速掌握最优生产逻辑, 避免经验流失。

Local LLM + RAG process knowledge base enables one-click natural language queries of batch data. All analysis pages automatically generate AI-powered process interpretations and output optimization recommendations. Digital preservation of golden batch process experience allows new operators to quickly grasp optimal production logic and prevents the loss of expertise.



#### 06 工艺数据专属保密

Process data with exclusive confidentiality.

系统内置分级数据隔离机制, 黄金批次工艺轨迹、菌种代谢参数、最优补料方案等核心工艺数据按权限隔离; 单批次分析报告、AI 工艺洞察仅授权人员可查看导出, 黄金批次基准库支持加密锁定, 严防核心最优工艺外泄。

The system features a built-in tiered data isolation mechanism. Core process data such as golden batch process trajectories, strain metabolic parameters, and optimal feeding strategies are isolated based on access permissions. Single-batch analysis reports and AI process insights are viewable and exportable only by authorized personnel. The golden batch benchmark library supports encrypted locking to strictly prevent the leakage of proprietary optimal processes.

#### 07 配套辅助功能, 使用简洁高效

Supporting Features – Simple & Efficient

##### 1 多维可视化驾驶舱

三维厂区设备漫游巡检、生产数据大屏一屏展示设备状态、实时指标、黄金批次滚动数据。

##### 2 平台基础运维能力

模块化可拓展架构, 高性能、操作简单; 配套权限管理、数据加密、自定义报表设计功能。



##### Multi-Dimensional Visual Cockpit

3D plant equipment roaming inspection, production data dashboard displaying equipment status, real-time indicators, and rolling golden batch data on a single screen.

##### Basic Platform Operations & Maintenance Capabilities

Modular and scalable architecture with high performance and easy operation. Equipped with permission management, data encryption, and custom report design functionalities.

