



环保压力：我国电解锰行业 新的挑战 and 机遇

Environmental protection pressure: new
challenges and opportunities for China's EMM
industry

段宁 博士

中国环境科学研究院

Chinese research Academy of Environmental
Sciences



中国环境科学研究院

2010. 03. 23

内容

1

我国电解锰行业面临的新挑战

Challenge for china's EMM industries

2

电解锰行业清洁生产原理

**principles of cleaner
production in EMM industry**

3

电解锰行业清洁生产技术

**Cleaner production technology in
EMM industry**



1、我国电解锰行业面临的新挑战

重金属

heavy metal

氨 氮

Ammonia ['æməʊnjə]

nitrogen ['naitrədʒən]



1、我国电解锰行业面临的新挑战



2009年7月, 湖南长沙湘和化工厂未经审批非法从事炼铟和炼镉生产, 造成周边土壤受到镉污染, 509人检出镉超标, 引发浏阳市镇头镇数千群众上街抗议。

In July, 2009, Changsha Xianghe Chemical Factory conducted illegal 'indium-smelting and 'cadmium smelting without government approval, causing cadmium pollution in local land. 509 local residents were diagnosed with cadmium excess. As a result, thousands of people of Zhentou County Liuyang City staged a protest.



1、我国电解锰行业面临的新挑战



2009年8月，陕西凤翔长青镇东岭集团冶炼公司铅污染造成附近村庄615名儿童血铅超标。

In Aug 2009, Dongling Group Metallurgical Company in Changqing county, Shaanxi province, caused severe lead pollution. As a result, 615 children suffered from of PbB (blood lead) excess.



2009年8月，湖南武冈市文坪镇一些小企业利用电解锰厂阳极泥为原料进行生产，导致附近村庄1354名儿童血铅超标。

In Aug 2009, in Wenping county, wugang city, Hunan province, , some small enterprises used anode mud from EMM plants as raw materials for their own production, leading to 1354 children suffering from PbB (blood lead) excess



1、我国电解锰行业面临的新挑战



2008年，云南九大高原湖泊之一的阳宗海砷污染，直接危及20,000人的饮水安全。

In 2008, Yangzonghai lake, one of the most famous nine plateau lakes in Yunnan province was subjected to ‘arsenic pollution, undermining the drinking water safety of over 20,000 people.



2008年，广西河池砷污染事件。柳州华锡集团金海冶金化工公司排放的废水砷导致450人砷超标。

In 2008, Guangxi Hechi city was subjected to ‘arsenic pollution. The waste water discharged by Liuzhou Huaxi Group Jinhai metallurgy chemical company lead to arsenic excess in 450 people.



1、我国电解锰行业面临的新挑战

1. 从环境污染方面来看，重金属如汞、镉、铅、铬及类金属砷等毒性显著。我国重金属污染形势十分严峻，局部重金属污染呈现恶化趋势。近年来，重金属污染事件进入集中爆发期，

Regarding environmental pollution, heavy metals like hydrargyrum [hai'drɑ:dzirəm], cadmium, chromium, 'metalloid and arsenic are all badly toxic. China's heavy metal pollution problem is very acute with regional heavy metal pollution getting worse. In recent years, heavy metal pollution incidents reached its peak.

2. 仅2009年，环境保护部就接报了陕西凤翔、湖南武冈、云南东川等12起重金属、类金属污染事件。这些事件致使4035人血铅超标、数百人镉超标、引发32起群众性事件。 In 2009 only, the Ministry of Environmental Protection received 12 heavy metal and metalloid pollution incidents cases including Fengxiang in Shaanxi province, Wugang in Wuhan province and Dongchuan Yunnan province. These incidents have caused blood lead excess in 4035 people, chromium excess to hundreds of people and 32 collective incidents like protests.



1、我国电解锰行业面临的新挑战

3. 由于重金属污染严重危害当地群众的身体健康，引发了上下游间的矛盾影响了社会稳定引起全社会高度关注。重金属污染具有长期累积的特点，而污染事件的曝光正是累积后污染后果爆发的显现。

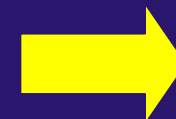
Heavy metal pollution has severely harmed local people's health and fueled conflicts between enterprises and local residents, thus hampering social stability. It has aroused close concern from the entire society. Heavy metal pollution can accumulate over time and the explosion of pollution incidents just bring to light the consequence of the accumulated pollution.


1. 为应对重金属污染问题，2009年国家环境保护部联合国务院9部门开展重金属污染企业专项检查，共检查企业9,123家，查处环境违法企业2,183家，取缔关闭231家，停产整治641家。

To tackle the heavy metal pollution issue, Ministry of EP of PRC and nine departments from the state council conducted a special examination on enterprises' heavy metal pollution in 2009, examining 9,123 enterprises, punishing 2,183 illegal ones, banning and closing 231 and stopping production of 641.

2. 鉴于当前我国面临突出的重金属污染问题，环保部于2009年4月召开全国重金属污染防治工作会议，原则上通过了《全国重金属污染综合整治实施方案》，强调要把重金属污染防治摆在更加紧迫、更加重要的位置，采取有力措施，大力防控和应对重金属污染，切实解决危害群众健康的突出环境问题。

2. Given the acute heavy metal pollution problem in China, Ministry of EP of PRC held a national Working Group Meeting on heavy metal pollution prevention in April 2009 and passed the 'National Implementation proposal on comprehensive treatment of HM pollution'. Since then, the issue of Heavy metal pollution has been put at a more urgent and important place. Effective measures have been adopted to vigorously prevent and tackle metal pollution to address the pronounced environmental issue that are health hazards to the public.





3. 国务院办公厅已批转《关于加强重金属污染防治工作的指导意见》（国办发[2009]61号），明确了重金属污染防治目标任务、工作重点及加大资金投入等保障措施

3. **General Office of the State Council** has write comments on and pass around the 《**Guidelines on strengthening HM pollution prevention work**》, which stipulated the objectives and priorities in heavy metal pollution prevention and supporting measures like increasing investment in this field.

1、我国电解锰行业面临的新挑战

2010年1月25日，环保部周生贤部长在全国环境保护工作会议上的重要讲话指出，2010年我国环保工作的重点之一是**集中精力解决重金属污染问题**：

on Jan 25, 2010, Zhou Shengxian, Minister of EP of PRC delivered an important speech at the Working Conference on National Environmental Protection and pointed out that one of the priorities of the environmental protection in 2010 is to concentrate on tackling heavy metal pollution.

1) 全面排查重金属污染物排放企业及其周边区域的环境隐患，确定重点防控区域、行业、企业和高风险人群，集中解决一批突出问题；

1) Efforts should be made to examine heavy metal pollutant emission by enterprises, identify and eliminate hidden environmental danger, identify key prevention areas, industries, enterprise and high-risk population and focus on solving a series of acute problems.



1、我国电解锰行业面临的新挑战

2)2010年6月底前将编制完成重金属污染综合防治规划并报国务院批准实施；

2)By the end of June 2010, a plan on comprehensive prevention and control of heavy metal pollution will have be formulated and submitted to the State Council for approval and later put into implementation.

3) 抓紧制定重金属污染综合防治规划实施考核办法；

3) The government will also accelerate the formulation of the Assessment Methods on the implementation of the 《plan on comprehensive prevention and control of heavy metal pollution》

4) 深化重金属检测工作，落实《“锰三角”地区地表水监测方案》。

4) the government will strengthen heavy metal testing work and implement the *Master Plan on Monitoring Surface Water in Mn Delta*.

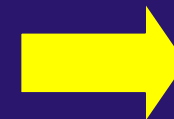


氨氮、氮氧化物被纳入“十二五”约束性指标

**ammonia nitrogen &
nitrogen oxide were included in the
“12th five-year plan” Bounded Target**

1. 环保部近日召开的2010年全国环境保护工作会议研究了《国家环境保护“十二五”规划基本思路》，提出“十二五”期间我国污染物总量控制计划将由“十一五”的单因子减排转入多因子减排，氨氮、氮氧化物的减排将被纳入新的约束性指标进行考核。

1. A few days ago, the Ministry of EP of PR held 2010 Working Conference on National Environmental Protection, at which the 《Basic Approach for the Plan on National EP》 was studied. It's put forward that the national pollutant control plan should include emission reduction of new pollutants like ammonia nitrogen and nitrogen oxide.



氨氮、氮氧化物被纳入“十二五”约束性指标

**ammonia nitrogen &
nitrogen oxide were included in the
“12th five-year plan” Bounded Target**

2. “十二五”规划的约束性削减指标包括二氧化硫、化学需氧量、氨氮、氮氧化物，这四种污染物将被列入即将公布执行2010年国家资源环境统计指标体系。到2015年，在化学需氧量、二氧化硫排放量比2010年削减5-10%的基础上，将氨氮、氮氧化物纳入减排计划，减排幅度按5-10%考虑。

2. The 12 five-year plan emission reduction bounded target includes the sulfur dioxide, chemical oxygen demand (COD), ammonia nitrogen and nitrogen oxide. These 4 pollutants will be listed in the 2010 National Resource Environment Statical Target System. By 2015, when **chemical oxygen demand (COD) and sulfur dioxide emission will have been reduced by 5-10% on 2010**, ammonia nitrogen and nitrogen oxide will be listed in the Emission Reduction Plan to be reduced by 5-10%.



2、电解锰行业清洁生产原理principles

清洁生产的定义 Definition of Cleaner Production

❖ 联合国环境规划署的定义：

清洁生产是指将整体预防的环境战略持续应用于生产过程、产品和服务中，以期增加生态效率并减少对人类和环境的风险。

Definition by United Nations Environment Programme:

"Cleaner Production is the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase overall efficiency, and reduce risks to humans and the environment."

——对生产过程，要求节约原材料和能源，淘汰有毒原材料，减降所有废弃物的数量和毒性；

For production processes, Cleaner Production results from one or a combination of conserving raw materials and energy; eliminating toxic and dangerous raw materials; and reducing the quantity and toxicity of all emissions and wastes at source during the production process.



2、电解锰行业清洁生产原理principles

清洁生产的定义 Definition of Cleaner Production

- ❖ ——对产品，要求减少从原材料提炼到产品最终处置的全生命周期的不利影响；

For products, Cleaner Production aims to reduce the environmental, health and safety impacts of products over their entire life cycles, from raw materials extraction to the 'ultimate' disposal of the product

- 对服务，要求将环境因素纳入设计和所提供的服务中。

For services, Cleaner Production implies incorporating environmental concerns into designing and delivering services.



<http://www.unep.fr/scp/cp/understanding/>



2、电解锰行业清洁生产原理

❖ 《清洁生产促进法》中的定义：

❖ Definition in the Promoting Cleaner Production Law

清洁生产是指不断采取改进设计、使用清洁的能源和原料、采用先进的工艺技术与设备、改善管理、综合利用等措施，从源头削减污染，提高资源利用效率，减少或者避免生产、服务和产品使用过程中污染物的产生和排放，以减轻或者消除对人类健康和环境的危害。

Cleaner production means the continuous application of measures for design improvement, utilization of clean energy and raw materials, the implementation of advanced processes, technologies and equipment, improvement of management and comprehensive utilization of resources to reduce pollution at source, enhance the rates of resource utilization efficiency, reduce or avoid pollution generation and discharge in the course of production, provision of services and product use, so as to decrease harm to the health of human beings and the environment.

<http://www.chinacp.org.cn/newcn/chinacp/cplaw.htm>

http://www.chinacp.org.cn/eng/cppolicystrategy/cp_la



2、电解锰行业清洁生产原理



清洁生产的三个层次

3 levels of cleaner production

2、电解锰行业清洁生产原理

对于生产全过程产生废弃物的原因分析及清洁生产方案的产生，可从以下8个方面来进行分析和收集。

原辅材料和能源
Raw Materials and energy

技术工艺

过程控制
Process control

设备

管理

员工

废弃物
Emissions and wastes

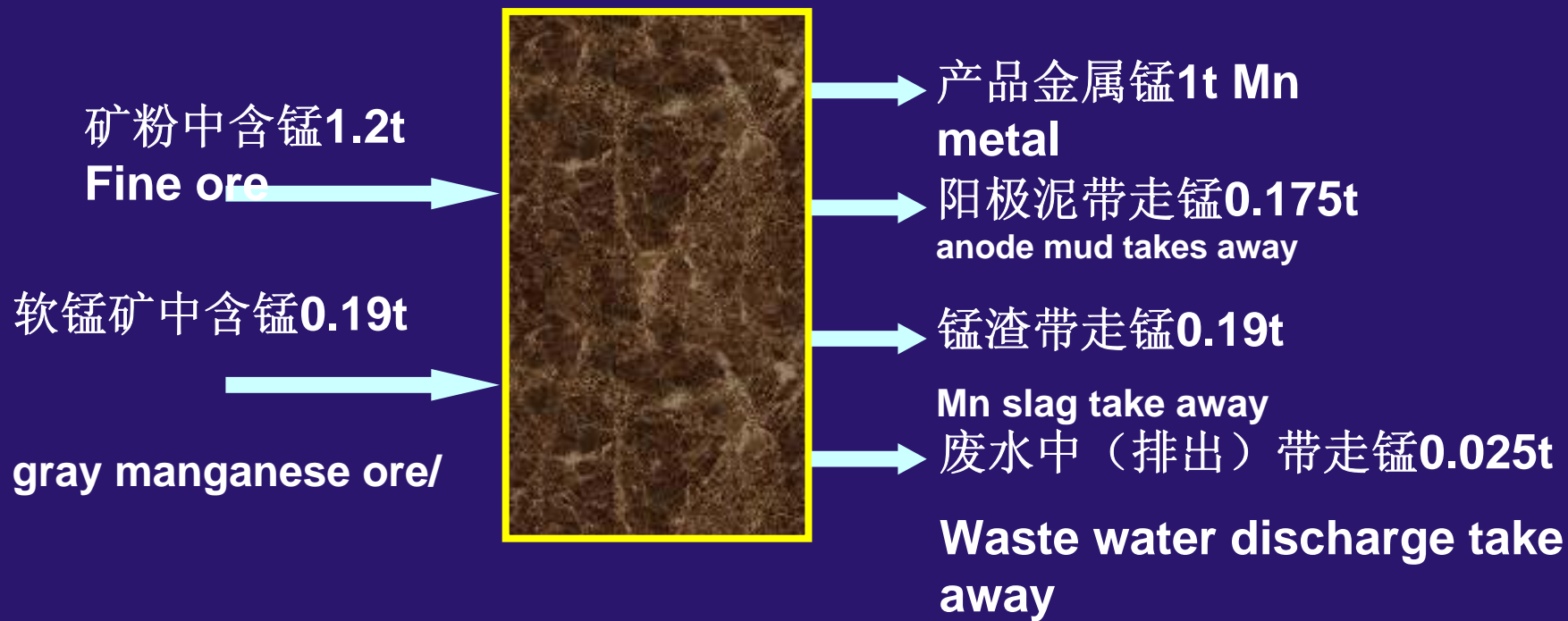
产品

清洁生产的8条途径

8 approaches of Cleaner production



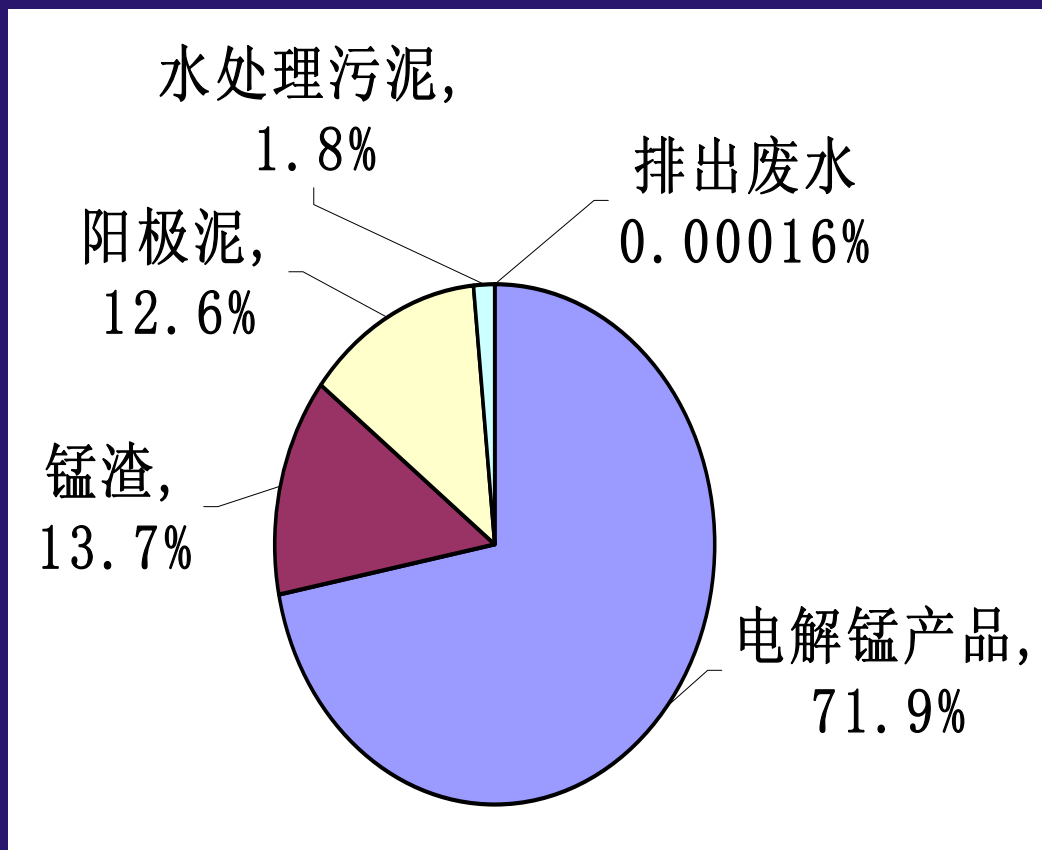
2、电解锰行业清洁生产原理



锰平衡图(以生产一吨电解锰计)

Balance of Mn during
production (per ton of E Mn)

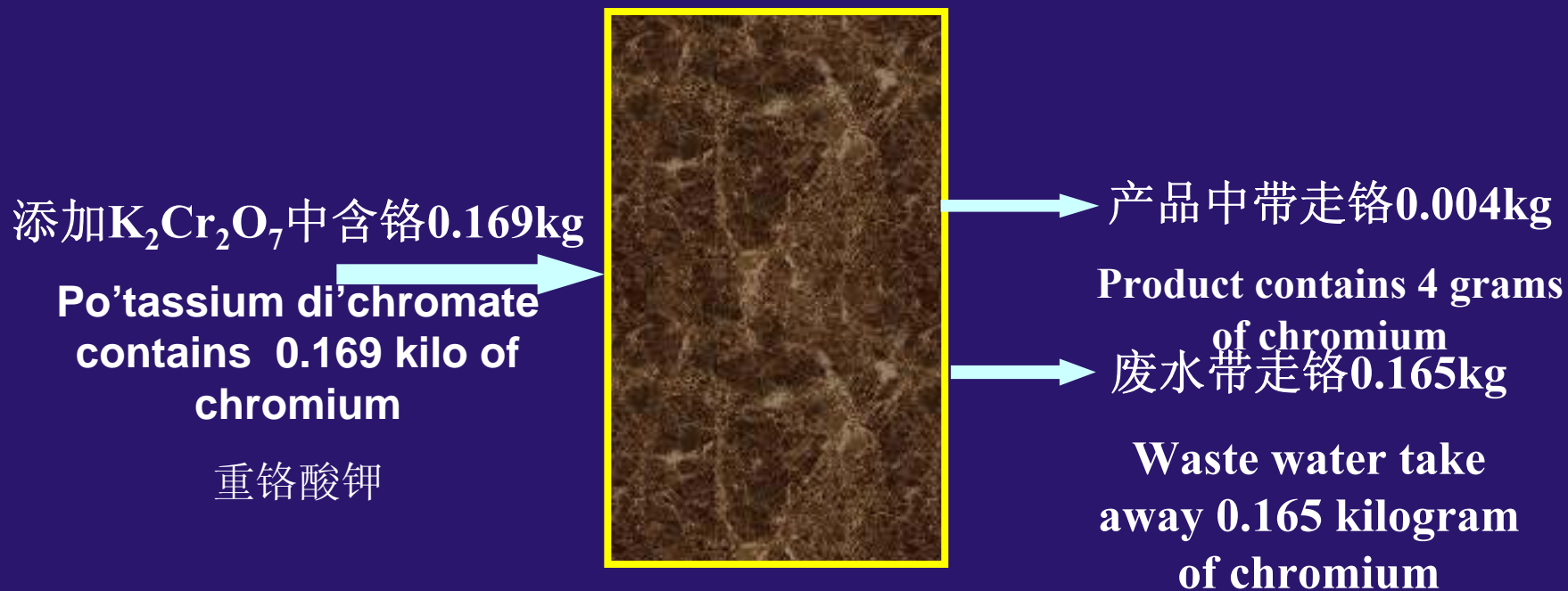
2、电解锰行业清洁生产原理



- water treatment Sludge
- Waste water
- Mn slag
- Mn product

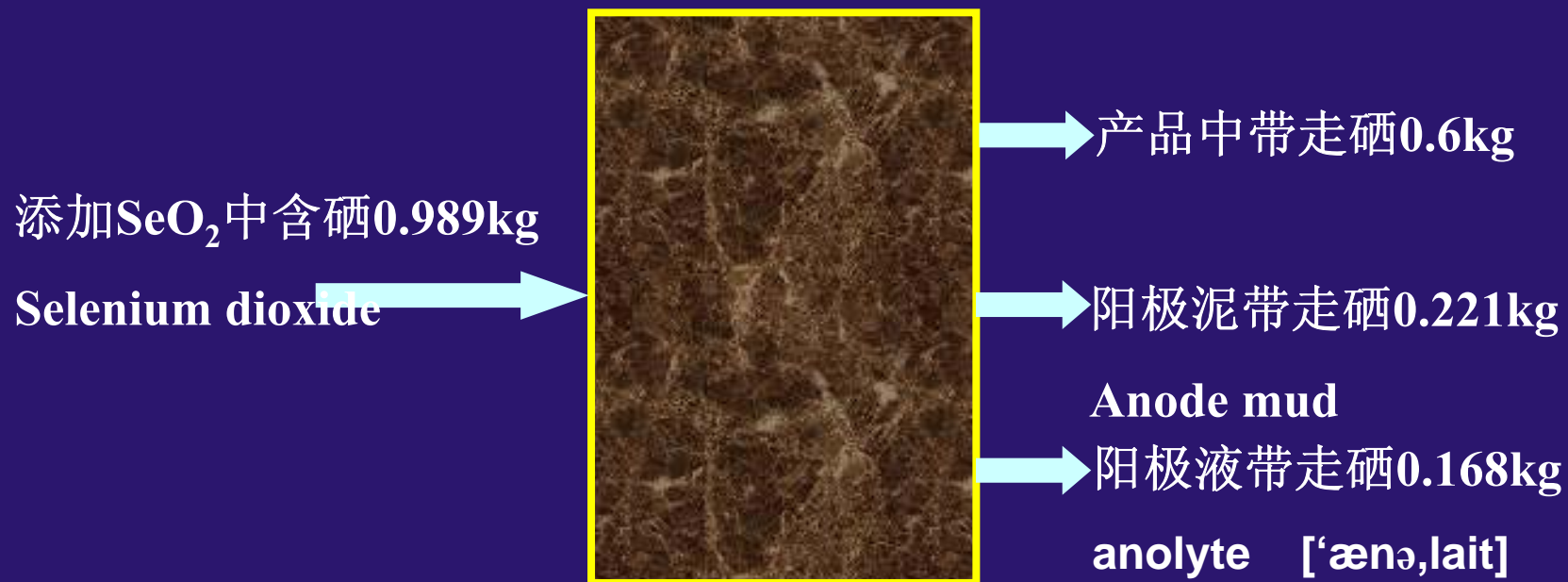
根据锰的物料平衡，进入产品中的锰为71.9%，进入环境的锰为38.1%。71.9% of Mn goes into the product and 38,1% goes into the environment

2、电解锰行业清洁生产原理



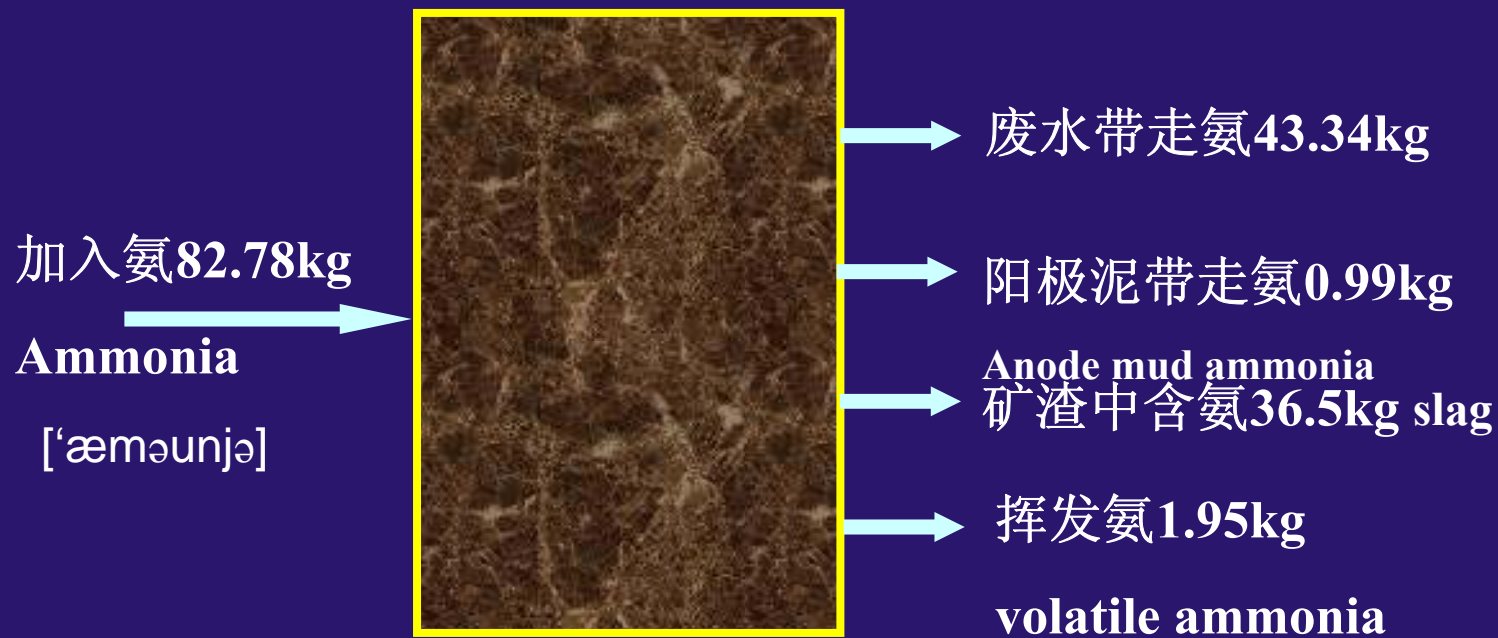
铬平衡图(以生产一吨电解锰计)
chromium

2、电解锰行业清洁生产原理



硒平衡图(以生产一吨电解锰计)
selenium

2、电解锰行业清洁生产原理

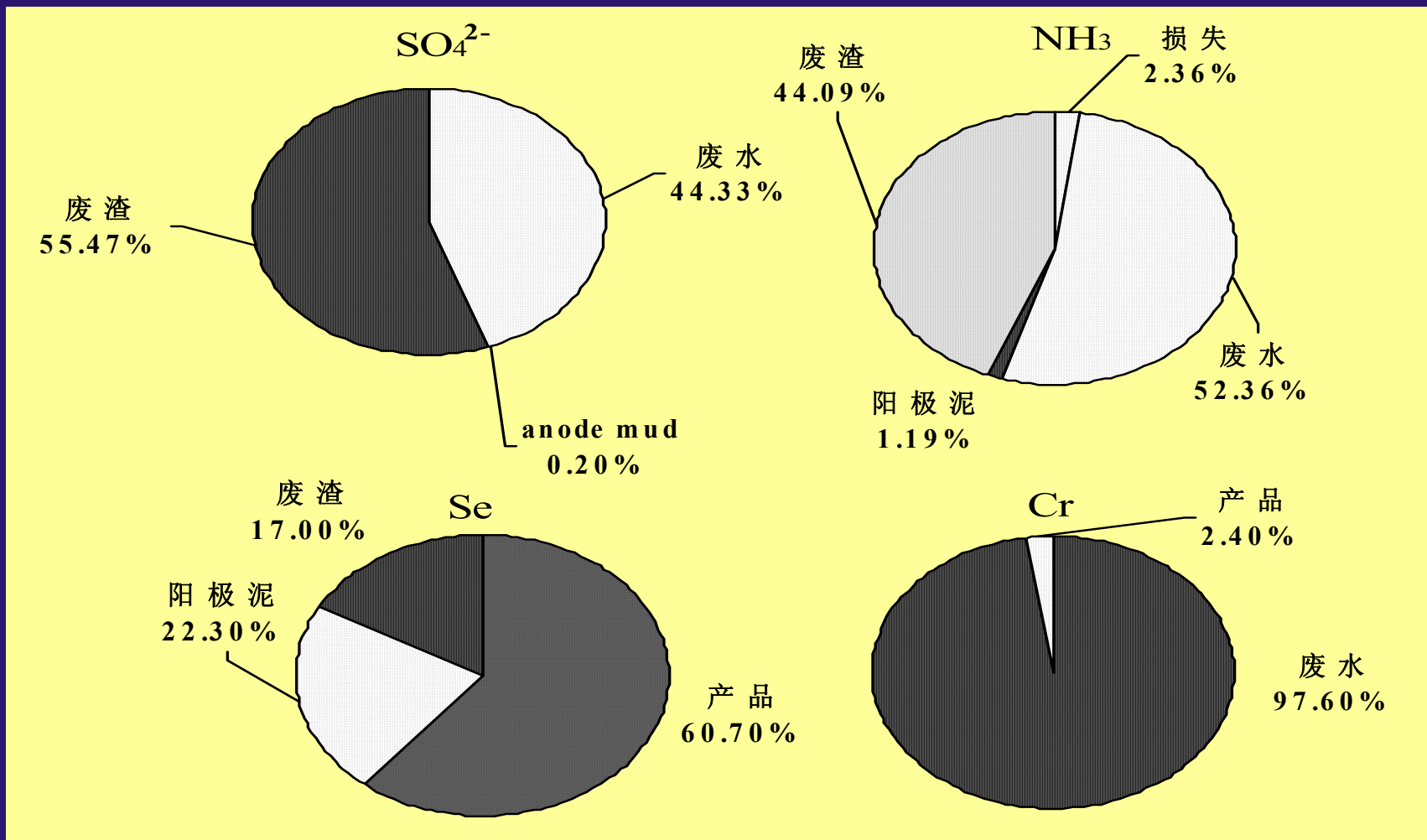


氨平衡图(以生产一吨电解锰计)

ammonia [ˈæməʊnjə]

2、电解锰行业清洁生产原理

NH₃ : ammonia



我们的利润流失到哪儿去了？

Where dose our profit go?



锰



铬

chromium



硒

selenium



氨

ammonia



清洁生产是电解锰企业的唯一出路

Cleaner production is the only way out for EMM industry

清洁生产是一种创造性的环境战略，该战略将全过程控制、污染预防的思想持续应用于生产过程、产品和服务中，通过不断加强企业管理和持续的技术进步，在提高资源利用效率的同时，减少污染物的产生和排放，实现经济效益和环境效益的统一。

cleaner production is a creative environmental strategy. It continuously apply the idea of whole-process control and pollution prevention to production, product and service. By constantly enhancing enterprises' management and technology progress, improving resource efficiency and reducing generation and emissions of pollutants, it achieves both economic benefits and good environmental performance.



清洁生产是电解锰企业的唯一出路

Cleaner production is the only way out for EMM industry

清洁生产

清洁生产技术深入到生产过程中，重点是工艺技术的改造，减少生产过程中污染物的产生，减轻末端处理的压力，同时为企业带来经济效益，调动其积极性和主动性，能够在根本上消除环境污染问题。

Cleaner Production technology is applied to the production and the renovation of process & technology. It can reduce pollutant emissions and the end-of-line treatment pressure, creating good economic results and helping enterprises be proactive in tackling environmental problems, thus solving environmental problems thoroughly.

末端控制

末端控制技术与生产脱节，基建投资大、运行成本高，容易造成二次污染，而且在经济上往往只有投入没有收益，容易导致企业与政府对峙，导致企业偷排漏排和污染反弹。

end-of-line control technology is isolated from the production. High Investment in infrastructure and high operation cost will lead to secondary pollution and low economic returns. Therefore, it may fuel confliction between enterprises and the government and cause enterprises to emission treatment evasion and pollution rebounding.

清洁生产是电解锰企业的唯一出路

大力加强环境
孕育清洁生产技术

**Vigorously strengthen environmental
supervision, develop cleaner production**

推广清洁生产技术
**popularize cleaner
production
technology**

提升企业科技含量

清洁生产 政企双赢

**CP win-win for Gov and
enterprises**

3、电解锰行业清洁生产技术

技术路线

源头控制、过程减排和末端循环**并举**

control at the source, reduce
emissions during production and end-of-
line circulation

以污染预防为**重点** priority should be given to
pollution prevention

以科技减排为**核心** core strategy: apply
technology to reduce emission

3、电解锰行业清洁生产技术

技术路线

- 以工艺无害化、设备封闭化、操作自动化、计量精准化为特征 harmless process, closed equipment, automatic operation, accurate computation
- 以水平衡为主轴 we should also try to achieve water balance

3、电解锰行业清洁生产技术 CP technology for EMM industry

目标

主要通过推行清洁生产和循环经济技术，到2012年污染物排放大幅下降，二氧化硒和重铬酸钾投加量显著减少，建立起将电解锰行业由高污染、高物耗、低技术水平提升为高科技、高效益和低污染行业的以清洁生产和循环经济技术为主体的污染防治技术体系。

Our objective is to, by promoting cleaner production and circular economy technologies application, significantly reduce pollutant emission by 2012, lower usage of selenium dioxide and potassium dichromate, develop pollution prevention and treatment technological system to transfer EMM industry from a high resource consumption, high-pollution and low-technology one to a high-technology, high-efficiency and low-pollution one which relies on cleaner production and circular economy technologies.

3、电解锰行业清洁生产技术

目标

到2015年，全面取缔开放式矿石粉碎和矿粉输送系统，推广先进高效固液分离工艺，淘汰铁屑还原、石灰法中和还原的末端废水处理技术，基本完成全行业结构调整，建立起一批工艺无害化、设备封闭化、操作自动化和计量精准化的大型现代化电解锰企业，大幅度提高行业集约化程度。

By 2015, the government will ban open ore crushing and powdered ore transportation system. Promote solid-liquid separation technology. Eliminate scrap iron reduction, lime neutralization reduction for end-of-line WW treatment technology and establish large modernized EMM enterprises with harmless process, closed equipment, automatic operation and accurate computation, thus highly improve the industry's intensification.

污染物源头控制技术

- ❖ 在有条件的地方，提倡我国电解锰企业充分利用国外矿石资源，如在沿海和交通便利地区，积极从国外进口高品位锰矿。
- ❖ In places where condition permits, China's EMM enterprises can make full use of foreign ore resources, for instance, enterprises in coastal areas or areas with convenient transportation, should actively import high-grade Mn ore from abroad.
- ❖ 积极研发我国贫锰矿富集技术；鼓励采用粗粒干选——细粒湿选的全磁选、浮选等先进选矿工艺技术及装备，多方式分选利用贫锰矿，实现选矿产品的精细化。
- ❖ We should also make efforts to develop low-Mn ore concentration technology and use advanced ore dressing technologies and equipment like magnetic separation and flotation with coarse grain dry separation and fine grain wet concentration so as to concentrate and make full use of low-Mn ore, thus refining ore dressing products.

污染物源头控制技术

- ❖ 加快研发利用二氧化锰矿作原料的先进还原工艺技术及设备。
- ❖ **We should accelerate the research and development of advanced reduction process, technology and equipment using Mn dioxide as raw material.**
- ❖ 加快完善和推广低硒、无硒电解技术，吨电解锰用硒量下降到1.2千克以下。
- ❖ **We should speed up the improvement and popularization of low-selenium and selenium-free electrolyte technology to reduce the usage of selenium to less than 1.2 kilograms per ton of EMM.**
- ❖ 大力鼓励研发、示范和推广无铬钝化技术。
- ❖ **We should encourage Developing, demonstrating and promoting Chrome-Free passivation technology.**

污染物生产过程减排技术

- ❖ 在制粉工序，推行负压粉碎技术及高封闭性物料收集和运输系统，提高锰矿粉利用率，降低粉尘污染。
- ❖ In the milling process, we should apply the negative-pressure grinding technology and highly-closed material collecting and transporting system, so as to improve the utilization of High-Mn fine ore and reduce dust pollution.
- ❖ 如节能高效封闭负压磨机+除尘器+罐装车系统、节能高效封闭负压磨机+除尘器+密闭输送管路等，削减量工业粉尘90%以上。
- ❖ For instance, we can use energy efficient vacuum-assisted closed mill+ dust separator + canned vehicle systems, or energy efficient vacuum-assisted closure mill+ dust remover +closed conveyor pipe, reducing industry dust by 90%.

污染物生产过程减排技术

- ❖ 在化工工序，推广使用酸雾吸收装置，防止酸雾排放。鼓励采用氧气、双氧水等清洁环保型氧化剂，替代部分或全部二氧化锰的使用。
- ❖ **in chemical combination process, we can Use acid fog absorption equipment to avoid acid fog emission. We encourage the using of Oxygen and Hydrogen Pe'roxide and other environmental friendly oxidants to replace part of or all Mn dioxide.**

污染物生产过程减排技术

- ❖ 在一榨工序，大力推广先进的高效固液分离工艺技术及装备，如以高效压滤为特征的二段酸浸洗涤压滤技术及其它降低锰渣中可溶性锰含量的同类技术，实现锰渣中（酸）可溶性锰含量低于2%，锰渣二次压榨含水率低于28%，逐步淘汰不能达到上述目标的压滤技术。
- ❖ **In the first pressing process, we should vigorously promote advanced high-efficiency solid-liquid-separation process, technology and equipment used. For example, sec acid washing and pressure filtration technology characterized by highly efficient pressure filtration and other technology to reduce the conten of Soluble/solvable Mn in Mn slag.**

污染物生产过程减排技术

- ❖ 积极推广新型、环保、高效的电解槽，采用新型材料及其工艺技术和设备，提高电解和电流效率，如采用阳极液断流器等技术。//在化合工序，推广使用酸雾吸收装置，防止酸雾排放。鼓励采用氧气、双氧水等清洁环保型氧化剂，替代部分或全部二氧化锰的使用。
- ❖ We should also actively promote new type, environmental friendly electrolytic bath, use new materials and corresponding process, technology and equipment. Improve electrolyte and electric current efficiency, anolyte ['ænə,lait] current breaker.
- ❖ In chemical combination process, use acid fog absorption equipment in chemical combination to prevent acid fog emission. Oxygen and Hydrogen Peroxide and other environmental friendly oxidants to replace part of or all Mn

污染物生产过程减排技术

- ❖ 积极推广阴极板出槽—钝化—清洗—烘干—剥离—洗板—浸油—入槽等工序的一体化自动控制流水线，回收阴极板出槽和钝化工序带出的电解液和钝化剂，从源头削减电解车间水污染和粉尘污染，减少废水中锰和铬60%以上，减排金属粉尘70%以上；降低工人劳动强度和可能受到的健康危害，减少操作人员用工70%以上，逐步淘汰传统的劳动密集型出槽和钝化方法。
- ❖ Actively promote the unified automatic assembly line, including plate discharge chute - passivation-cleaning-drying-strip-platewashing-Oiling –into the chute. The electrolyte and blunt agent of recycling cathode plates out of slot and passivation process, reduce at the source electrolyte workshop pollution and dust pollution, reduce Mn and chromium in waste water by 60%, and metal dust by 70%, reduce labor intensity and possible health hazard, reduce operators by 70% and gradually eliminate labor-intensive out of chute and passivation.

污染物生产过程减排技术

❖ 加强节能降耗

❖ Enhance energy saving

(1) 加强对企业用水量的监控，杜绝粗放式的水资源使用行为。

(1) We should strengthen monitoring on enterprises' water consumption, and Eradicate the extensive using of water.



污染物生产过程减排技术

❖ 加强节能降耗

❖ Enhance energy saving

- (2) 大力鼓励在电解锰企业生产中推广节能节电工艺技术，力争吨含硒产品（碳酸锰矿原料）直流电耗不高于5500千瓦·时，吨无硒产品（碳酸锰矿原料）直流电耗不高于7500千瓦·时。
- (2) Strongly encourage using of energy-saving technology in EMM production, and achieve Selenium-products (Mn carbonate material) DC consumption not higher than 55 hundred kilowatt, and Selenium-free product DC consumption per ton not higher than 75 hundred kilowatt.

污染物生产过程减排技术

❖ 产品开发优化 optimizing product development

(1) 延长电解锰及锰矿深加工行业产业链，积极开发高附加值锰系产品。

Extend EMM and Mn products deep-processing industry chain, and develop high-value-added Mn product.

(2) 加快开发电解锰生产过程中钴、镍等伴生贵金属的提取和回收技术。

Accelerate developing the extraction and recovery technologies of co'balt, nickel and other associated precious metals in EMM production process.



废弃物末端循环及处理处置技术

- ❖ 大力提倡锰渣综合利用技术，推广以锰渣为原料生产建材制品、建材原料、路基材料等技术，鼓励研发大量利用锰渣制备高附加值产品的技术。
- ❖ Strongly advocate Mn slag utilization technology, promote Mn slag used as raw materials to produce Building products, building raw materials, Roadbed material, encourage technology to use Mn slag to produce high-value-added products.

废弃物末端循环及处理处置技术

- ❖ 鼓励采用锰铬离子回收技术处理末端废水，回收并循环利用废水中的铬锰资源，废水稳定达到《污水综合排放标准》（GB 8978-1996）和地方标准。逐步淘汰铁屑还原和石灰中和方法为主的铬锰废水处理工艺技术。
- ❖ Encourage the use of Mn-Cr ion recycling technology to treat end-of-line waste water. Waste water discharge reach <Integrated wastewater discharge Standard>. Gradually eliminate the Cr-Mn wastewater treatment process using iron filings and lime restored materials.
- ❖ 鼓励开发和推广废水中氨氮回收和循环利用技术，加快实现全行业废水氨氮达标排放。Encourage developing and promoting ammonia-nitrogen recovery and recycle technology to achieve up-to-standard ammonia-nitrogen emission in waste water.

废弃物末端循环及处理处置技术

- ❖ 加强锰渣安全处理处置，规范锰渣库的建设和管理。锰渣库须符合《一般工业固体废物贮存、处置场污染控制标准》（GB18599-2001）规定。鼓励采用高密度聚乙烯（HDPE）人工膜等高新防渗材料，防止废渣渗滤液对环境的二次污染。
- ❖ We should enhance safe disposal of Mn slag, regulate construction and management of Mn slag warehouse, which should abide by <Standard for pollution control on the storage and disposal site for general industrial solid wastes> . We should promote impervious [im'pə:viəs] materials like artificial high-density HDPE 'membrane, and prevent secondary pollution by leachate ['li:tʃeit].



谢 谢!

Thank You!

