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GCI TECH NOTES©

GCI 的工艺摘要

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This is part of a series of GCI Tech Notes focusing on the early development of the hazardous waste fuels programs during the early 1980s. I was hired as the facility manager for the first commercial hazardous waste operation at a cement plant in early 1980. Many of the developments in storage, processing, testing and use of hazardous waste fuels were the result of work done at a handful of plants in the early and mid 80's. Look for issues to include topics on storage, lab testing methods, processing and the impact of HWF on cement product quality and production.

这是 一系列GCI 工艺摘要中的一部分，关注于上世纪80年代早期发展利用危险废物燃料的过程。 本文作者于80年代初被聘为项目经理，替一家水泥厂建立美国第一个作商业用途的、危险废物燃料的处理设施. 许多有关储存、加工、测捡和使用危险废物燃料的措施，就是于80年代早期和中期发展出来，在为数不多的几家水泥厂子里实践中得出的结果. 回顾一下遇到的一些问题；包括储存、化验室测试的方法、操作过程等，以及危险废物燃料对水泥产品的品质和生产方面的影响。

早期拒收的危险废物

By David Gossman（大伟 . 高士曼 著）

As a manager of a hazardous waste fuel facility one of the last things you want to do to a waste generating customer or blender is to reject a shipment. (The last thing you want is to have someone hurt.) Today less than one percent of shipments are rejected. Quality control by waste blenders and better control by waste generators keeps rejections low.

作为一个危险废物燃料处理设施的经理，我最不想对废物制造者、或废物燃料生产者做的事就是拒绝接受交来的废料（或者说是最不想得罪别人）. 如今还有低于 1%交来的废料被拒收，那是由于调配者和产生者采取了良好的质量控制，使得拒收率得以保持低下。

This was not always the case. As the first HWF facility at a cement plant with full quality control on incoming shipments in the early 80's we rejected about three percent of all incoming shipments. Waste generators under pressure by EPA to get rid of years worth of accumulated hazardous waste and blenders with little or no testing facilities created an environment where higher shipment rejection rates were a necessity.

这并非时常发生的事. 作为美国的第一个设置在一家水泥厂内的、有完善的质量控制的危险废物燃料处理设施，于 80 年代初我们拒收送来的废料约有 3%. 废料制造者和废物燃料调配者，在环保当局的压力下急于要处理掉多年积存的危险废料，其中有些进行或者甚至完全没有进行化验测试，因此废料拒收率偏高是出于必要。

小心含水量 Watch for Water

My first shipment rejection in Paulding, Ohio happened before the onsite lab was in place. The truck was full of water with a thin layer of solvent on top – something that can be seen when taking a sample. The VP in charge of sales was sure I was wrong but the lab confirmed my assessment. It is quite possible I would have been fired had I been wrong. I have always considered the cement plant burning the waste my first and most important customer – not all in the business have that attitude.

我第一次拒收交来的废料是 1980 年，在俄亥俄州、保定的水泥厂（如今是拉法基属下的厂子）. 事情发生于现场化验室建立之前. 那辆罐车满载着水，表面仅有薄薄一层溶剂 -- 在取样的时候很易察觉. 那位负责推销的副理肯定地说是我错了，但是化验室后来证实了我的判断. 如果那时我的判断错误，那么我肯定会被马上解雇. 我一直是为着那家燃烧废物的水泥厂考虑，因为那是我的第一个、也是最重要的顾客 - 不是所有的营商者都抱有那种态度。

A little over five years later, after being hired as McKesson Envirosystems' Marketing Manager I was asked to supervise the start up of their HWF program at San Juan Cement in Puerto Rico. I personally sampled and rejected the first shipment delivered to the cement plant – proving that even a dedicated offsite blending facility could not be counted on for all quality control of HWF. Again the issue was water – a problem to this day at HWF facilities. [Note: In many cases this is a matter of blending with other wastes properly.]

大约五年多之后，在我被聘请为McKesson Envirosystem的营销经理后，我被派去哥斯达黎加的San Juan水泥厂，监督他们实行危险废物作燃料的方案. 我亲自取样检查，并且拒收了第一批送达该水泥厂的废料；事实证明了就是从外边的一个专业的废物燃料生产设施交来的废物燃料, 你也不能信赖他们的质量控制. 问题还是水份，时至今日 -- 那里的废物燃料生产设施还存在着这个问题。[注：在好多情况下，这是如何恰当地与其它废物调配的事。]

检测含热量与含氯量
Heat & Chlorine Contents

Of course heat content and chlorine were also leading causes of shipment rejection – not enough of the former and too much of the latter. After six years of fighting to have HWF chlorine under 2-3 percent imagine my pleasure in setting a minimum specification for a plant at four percent chlorine and the maximum at eight percent. Even recently I suggested to one of my international cement plant clients that they find a waste fuel source containing chlorine – possibly PVC plastics – to improve the performance of their alkali bypass. Chlorine is not always a bad thing in cement kilns – one just needs to pay attention to the process chemistry. [Note: Again this is mostly a matter for proper blending.]

当然，含热量与氯气的含量也是拒收交来的废物燃料的首要原因 --- 前者往往不足、后者却又太多. 经过 6 年的抗争成功地把氯气的含量控制在 2 至 3 个百分比，对一个原来设计允许有含氯量 4%至 8% 的水泥厂而言我感到很满意. 就是在最近我也告诉一家国际上的水泥厂客户；如果他们在废物燃料中发现含氯气的话 --- 可能是来自 PVC 塑料 --- 建议他们改进碱性旁统管的功能. 水泥窑中有氯气并非一定是坏事 --- 但是有必要注意工序的化学作用。[注：同样，这也是关乎如何恰当调配的事。]

检测 PCB 含量 Test for PCB

One leading cause for shipment rejection in the early years was PCB contamination. In order to insure the success of the HWF program I had developed a procedure for performing accurate threshold testing of PCBs inside 30 minutes after the sample came into the lab.

早年拒收交来的废物燃料的首要原因是有 PCB 的玷污物质. 为了保证废物燃料方案的顺利进行，我发展出一个操作程序来执行正确把关，在样品送达实验室的 30 分钟内完成测试。[注：PCB = 聚氯化二苯，它是经生物堆积的复合物，本身无毒，但在加热后会释出有毒的二恶英 (Dioxin)]

Shortly thereafter Chemical Waste Management, trying to assert that they could not have prevented PCB contamination of the waste oil lagoon in Vickery, Ohio, claimed that shipment by shipment testing for PCBs would have taken too long and was therefore impractical. The Ohio EPA personnel involved knew better – they had visited the HWF facility I was managing. The result was the largest ever environmental fine at that time. – Over 10 million dollars to my recollection.

没多久之后,化工废料管理[公司的名称]籍口宣称他们没办法防止从俄亥俄州、维克雷地方的污泥槽里捞出来的废油被玷污，进行一批一批地化验测试 PCB 玷污物，因为费时太久，不切实际. 俄亥俄州的环保当局的有关人员却知道得更清楚 - 因为他们曾经来我管辖的废物燃料设施视察过. 结果[化工废料管理]被罚，付出当时的一次最高的环保罚款 - 据我记忆所及是一千万美元。

Another shipment was rejected for PCBs from a major pharmaceutical company. Not only were the generators in denial but the state of Michigan was rather unhappy - the other half of the contaminated tank was blended by Nortru and shipped to the Cadence steel mill waste fuel program – our primary competition at the time. The steel mills never did set up onsite testing of shipments. Surprisingly shipments still get rejected for PCBs – nearly 30 years after manufacturing ceased. [Note: The cement kiln can handle them it is the issue of worker exposure and community relations that is the issue. In the US those highly toxic wastes usually go to an incinerator, whereas in Norway it is also disposed of in rotary cement kiln. GCI has the know-how for disposing HW containing PCB safely in rotary cement kiln.]

另外有一批被我拒收的废料也是因为含有 PCB,那是来自一家颇具规模的制药厂. 不单是那家废料制造者[药厂],就是密契根州也非常不悦,因为另一半的玷污了的废料是由 Nortru 调配了送交 Cadence 炼钢厂作废物燃料使用 - 那家炼钢厂根本没有设立现场的进料化验测试的设备. 当时 Nortru 是我们的主要竞争者. 令人吃惊的是,PCB 于美国被禁止了将近 30 年之后,废物燃料中还有些因为含有 PCB 而被拒收 。[注:水泥回转窑可以处置含 PCB 的废料,问题在于员工和社区是否可以接受,在美国通常(由于社区的反对)那些高度有毒的废物都送往特殊的焚烧炉处置,而在挪威却也是用水泥回转窑处置。我们拥有技术利用水泥回转窑,可以安全地处置含有 PCB 的废料。]

检测金属含量

Test for Metal Contents

Rejection of shipments for metal contamination was relatively rare. I had set reasonably high and comfortable limits based on research into cement process chemistry and potential emissions and worker safety issues. Most of the limits have changed since then. That said I will never forget the shipment of waste paint from a toy manufacturer – over 1,000,000 ppm (mg/l) lead! The rejected shipment went to an incinerator in Ontario, Canada – apparently they had no lead limits or testing program! I immediately started testing all older painted toys in my house that my daughter might play with. [Note: Again this is a matter of proper blending.]

相对地说,废料因为含有金属而被拒收的是较为稀有. 根据我对生产水泥的化学作用的研究、排放的可能性和操作人员安全的考虑,我制订了恰当和放心的限度. 后来大部分的限度已有所变动。虽然这么说,我永不忘记那次从一家玩具制造厂送交来的一批废油漆 - 含有超过 1,000,000 ppm (或 mg/l) 的铅。[后来]那批被拒收的[废油漆]被送往在加拿大、Ontario 的一个焚烧炉 - 很明显哪里是没有含铅量的限制,或化验测试的程序!回家后我立刻开始测试我家里小女儿可能玩儿过的、那些涂了油漆的旧玩具。[注:同样,这是如何恰当地调配的事。]

检测挥发性和半挥发性的有机混合物
Test for Volatile and Semi-Voplatile Organic Compound

Another example of rejections was based on shipment by shipment testing of volatile and semi volatile organics found in the fuel. We rejected shipments with high levels of compounds that were more toxic than our PPE program allowed. [Note: Again, the cement kiln can handle them, it is the issue of worker exposure and community relations that is the issue. In the US those highly toxic wastes usually go to a special incinerator.]

另外一个被拒收的例子是因为；我们在每批废物燃料中测试到有挥发性和半挥发性的有机物质. 我们拒收的废物燃料中是含有高度的挥发性和半挥发性的混合物，其毒性比个人保护装备 [PPE = Personal Protective Equipment]允许的还要高。[注：同样地，水泥窑可以处置这些废料，问题是员工和社区是否接受，在美国通常[(由于社区的反对)那些高度有毒的废物都送往特殊的焚烧炉处置，但在挪威却也是用水泥回转窑处置。我们拥有技术利用水泥回转窑，安全地处置那些有毒的废料。]

检测其它的有毒物质 Test for Other Toxics

We also rejected the occasional shipment that would show up with a peak on the gas chromatograph we could not identify. (No mass spectrometer to help at that time.) One of the most persistent waste generators which we rejected shipments from (directly or indirectly through blenders) was the US Navy. Navy torpedo fuel, called Otto Fuel II, contains a high concentration (over 50%) of propylene glycol dinitrate. This is a potent nerve toxin with a **TLV** [TLV – Threshold Limit Value is the concentration in air that must not be exceeded for an 8 hr working day to protect employees from harmful impacts of] 0.05 ppm. It was implicated in a documented case of nerve damage among employees at a commercial incinerator in North Carolina during the mid 80's. If you are a hazardous waste fuel burner do you know that you are not receiving this waste? [Note: Exercise due precaution in testing for such highly toxic waste material, and proper blending with other wastes, it can be safely disposed of in rotary cement kiln for complete distruction.]

有时候我们也会拒收送来的废物燃料，因为气体色层分析仪的显示达到顶点，以致我们无法确定（那时我们还没有固体色层分析仪可用）. 一个经常被我们拒收废物制造者，直接或间接通过废物燃料调配者，就是美国海军。海军的鱼雷燃料，叫做 Otto Fuel II, 含有高度集中（超过 50%）的 propylene glycol dinitrate 这是一种强力的神经毒素，带有 TLV[Threshold Limit Value 最高允许的浓度（化学污染物浓度在人体代谢仍未受影响情况下之最高值), 也就是在一个 8 小时的工作天内[毒素]的浓度绝对不能超过这个限度，以保障工作人员不会受到伤害] 为 0.05 ppm. 它涉及一件有记载的事故；于 80 年代中、在北卡罗里那州的一个商业废物焚烧厂内、那里的一些雇员因此得了脑神经损伤. 如果你是一家危险废物燃料的使用者，你怎么知道不会收到这类废物？[注：经过严格地进行化验测试和恰当地与其它废料调配后，就算是这是含极毒的废料也可以在水泥窑中得到妥善和彻底的销毁。]

结 论 Summary

对于使用危险废物作燃料的危险性，是因员工会暴露于有毒的有机物质环境之中，所以每批交来的废料[或废物燃料]有必要进行化验测试各别的有机物质成分，那是最少受到监控而且往往被忽略了. 当今的 GC-MSD[Gas Chromatograph - Mass Spectrometer Detector 气体色谱分析和质量分析的测试仪器]技术使得测试比 20 年前要容易得多. 我还是认为这种程度的测试是必须的 （如有必要，应该拒收废物来料）对废物燃料生产者、或者是使用废物燃料的水泥厂是个关键的措施，那样才可以避免长远的事故责任。

Of all the hazards associated with using hazardous waste as fuel the issue of toxic organic exposure of employees and the need for shipment by shipment testing of individual organic constituents is the least regulated and most often overlooked. Current GC-MSD [Gas Chromatograph - Mass Spectrometer Detector.] technology makes this testing much easier than twenty years ago. I continue to believe that this level of testing (and rejecting shipments if needed) is a critical component for any waste fuel blender or cement manufacturer using hazardous waste fuels to avoid long term liabilities.

欲作更多咨询，或者你有什么经验可以与我们分享，请联系 Mr. David Gossman, 电话001-847-683-4188，或者发电邮 dgossman@gcisloutions.com 中国的朋友们可发电邮给我公司驻中国代表— 张启明先生 dennis.june@gcisolutions.com

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