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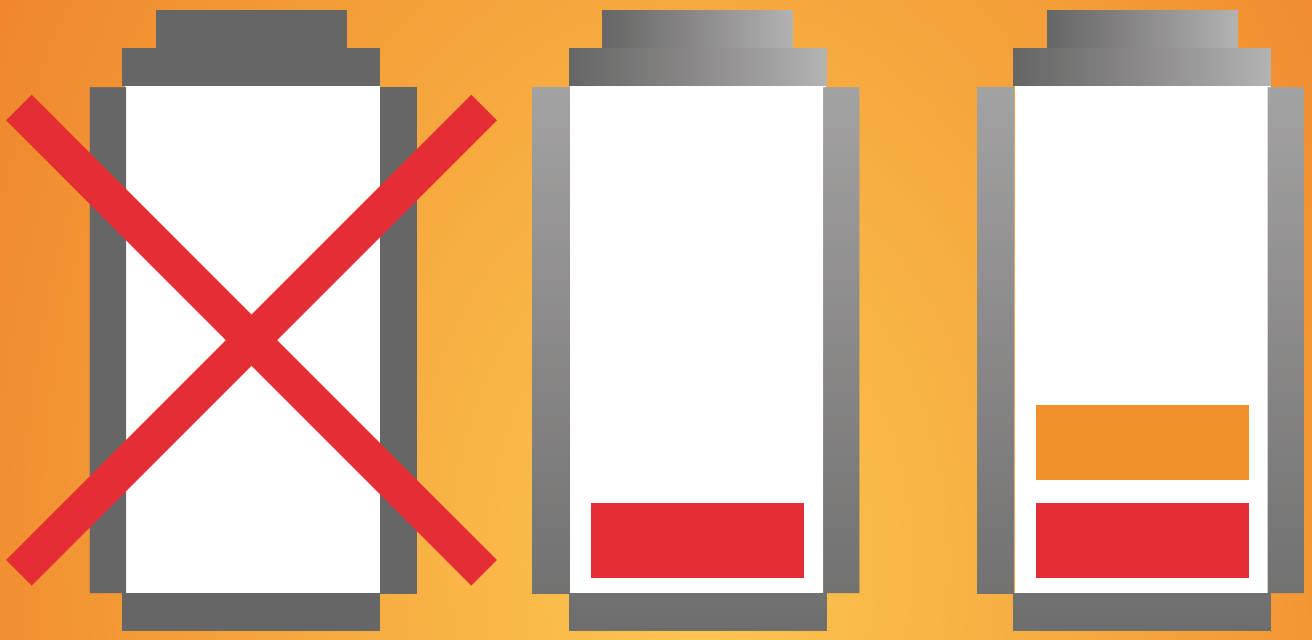
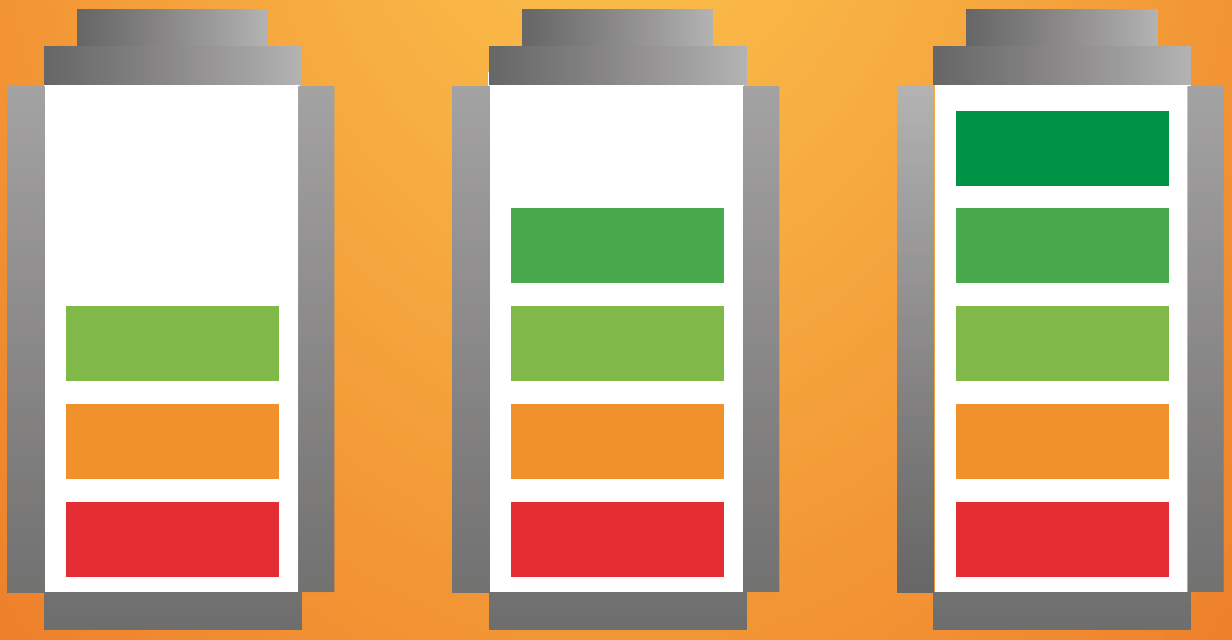


CHARGE AHEAD



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Left: Children playing in dirt and dust provides a major ingestion route for heavy metals

A poisonous legacy

Contaminated land and shaky legislation are huge problems in the former Soviet Union. **Jeff Temple** looks at Shymkent, Southern Kazakhstan, where 40,000 pre-school children are poisoned with lead

DOING business in the 15 countries of the Former Soviet Union (FSU) is full of opportunities, but it's not for the faint-hearted. The FSU has many regions contaminated through legacy pollution from industrial complexes. In the difficult times after the break-up of the USSR, new owners took over industrial enterprises from the state, without inheriting environmental obligations from historical contamination. The legacy contamination issues became orphaned, with no-one accepting ownership. We've heard many times (in various formats) that "the problems belong to the Soviet Union", a country which no longer exists. It's a true case of the buck stopping with no-one.

Companies considering investing or operating in the region need to bear in mind that legacy contamination, which may well be hidden, requires serious attention in terms of proper due diligence. At least one British company, which didn't perform a full prior risk assessment, has found this out to its cost.

This article highlights the case of the city of Shymkent, Southern Kazakhstan, with its still-operating lead smelter, where an estimated 40,000 pre-school children are poisoned with lead and other heavy metals. The issues concerning environmental legislation are raised, with discussion around the eventual remediation, as proposed by the International Task Force for Children's Environmental Health (ITFCEH) – see box. Legislative requirements for international companies intending to invest or operate in these regions are also discussed.

Members of ITFCEH first worked in Kazakhstan in the mid-1990s, on projects funded by the US Civilian Research and Development Foundation (CRDF), set up as part of the demilitarisation initiatives. Many state-of-the-art methods were used to determine environmental exposures of lead and poisoning of children across the whole country (see Table 1 for soil analysis for lead and arsenic). These analyses highlighted a severe problem in Shymkent, with the city's still-operating lead smelter identified as the cause.

The maximum soil lead concentration measured in the residential area (in the grounds of a kindergarten, about 1 km from the smelter) was 24,000 mg/kg. Meanwhile, the maximum legal level in Kazakhstan is just 32 mg/kg! The investigation effort continued in Shymkent, including mapping the whole town for metals in soil (including depth profile), in air and in children's blood. Special studies showed that the lead was found to be in an extremely high bioavailable state (100% bioavailable).

The results for lead in blood analyses in young children in Kazakhstan are shown in Table 2. Again, Shymkent stood out as a severe problem. In the schools in the region of the lead smelter, over 96% of children were found to be poisoned. The contaminated zone extends over 50 km^2, reaching close to the centre of Shymkent, with approximately 14 schools and kindergartens within the zone.

These results were presented to all levels in the national and regional governments, and in 2007 the President of Kazakhstan said that this was "one of the greatest environmental problems in Kazakhstan", and needed to be solved. Unfortunately, because no-one has

City	Pb (mg/kg)	As (mg/kg)
Almaty	7–97	ND*–22
Kyzlorda	29–5,628	9.3–756
Pavlodar	53–5,568	153–874
Taldy Korgan	33–5,958	ND*–160
Tekeli	43–3,612	9.3–88
Ust-Kamen	53–1,410	1–95
Shymkent	49–24,896	ND*–2,539
Legal limit in Kazakhstan	32	2

***ND** – Not detected (below detection limits of the analytical instrument)*

Table 1: Lead and arsenic ranges in soil in different cities of Kazakhstan

the effects of lead and other heavy metals

Lead is an extremely toxic chemical agent which is dangerous for people of all ages, but especially so for unborn children and those under six years. Lead enters the children's developing tissue in the nervous system with high absorption rates, and results in decreased IQ, loss of skills, behavioural problems, etc. At higher levels lead poisoning can result in death.

Lead damage is irreversible in young children and infants (see *Figure 1*, which is based on the World Health Organisation report, *Childhood Lead Poisoning*. According to this report, lead poisoning accounts for about 0.6% of the global burden of disease, but is entirely preventable.

Other heavy metals causing concern include arsenic and cadmium, both dangerous carcinogens in minute quantities.

Heavy metals are a concern when they are bioavailable (for example, if the metal can be dissolved in the human gut). A major ingestion route for children is playing in dirt and dust, with hand-to-mouth contact, although contaminants breathed from air emissions also pose a serious concern.

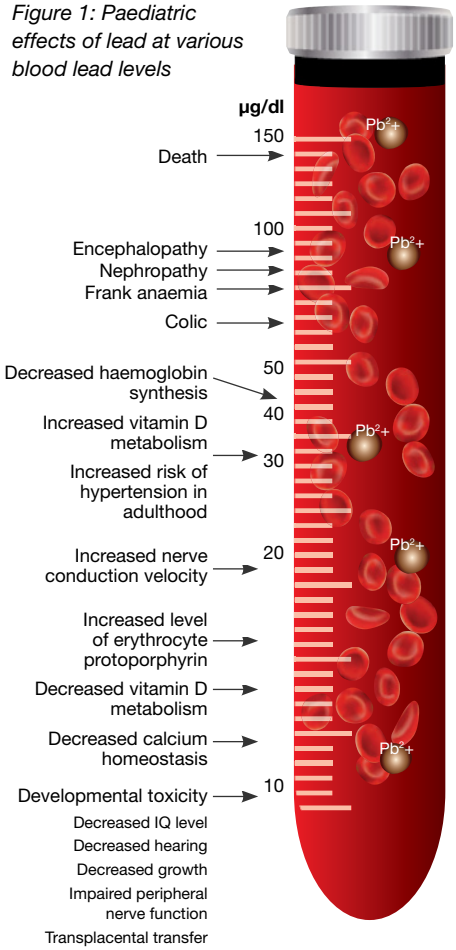

Figure 1: Paediatric effects of lead at various blood lead levels

ownership of the problem, nothing significant has been done. Worse still, the lead smelter has also been allowed to continue to operate despite not having proper emissions controls equipment.

environmental legislation in place…

The traditions of environmental regulation and enforcement in Kazakhstan are inherited from the late Soviet period. For example, the Tax Code regulates fees for permitted emissions; and the Administrative Code enforces fines for exceeding emissions. Since the end of the Soviet era, many international experts worked in Kazakhstan for the improvement of legislation, resulting in the new Ecological Code, which is considered to be a bridge between Soviet and Western principles (including integrated permits, BATs, etc). While this was signed into law in 2008, it's yet to be implemented in full. So, as Kazakhstan waits for the Ecological Code to emerge fully, the country has to make do with existing emission regulations. In theory, every operator should have a permit for air emissions, water discharge, and waste disposal. To get a permit for air emissions, the operator needs to demonstrate that the Maximum Allowable Concentrations of toxic compounds will not be exceeded at the line of the Sanitary Protective Zone, usually from a 1–3 km radius around the emission source. This demonstration should be done based on an Air Emission Dispersion model, produced by Soviet scientists in 1986 (usually referred to as 'OND 86', and still required in most post-Soviet countries) and using Gaussian equations (comparable to most of the computer models used in the West). For the initial permit, the Environmental Impact Assessment (EIA - Russian 'OVOS') is required with an estimate of the impact on air, water, soil, plants, public health, etc. Government environmental inspectors should regularly check that all emissions sources are counted in the calculations, that emission rates from the sources don't exceed the data accepted in calculations, and that other conditions of the permit are met. Government monitoring should collect data about the toxic compounds' concentrations in the city.

…but

For emissions compliance today, many local companies typically calculate dispersion to a location at 3 km from the plant, and easily prove compliance. However, since no 'sanitary zone' existed for many of the old Soviet facilities, populated areas were built close to the boundary. The distance chosen for the standard therefore has no relevance when residential areas are much closer.

The OVOS is usually prepared by local licensed companies whose independence is questionable (according to the local political situation), and the current level of the existing soil contamination is often ignored. The present standard for lead in soil (32 mg/kg) is very low, but in reality is a subject of theoretical debate only, with little real consequence. In Shymkent, for example, recent official data show the city is highly contaminated (with lead being more than 26 times the legal limit in soil, cadmium more than 40 times, and lead in air 2.6 times). As worrying as those figures are, there's no legal consequence for the regulated community. The reality is that inspection and monitoring structures aren't independent, and usually there are no or very few appropriate technical devices to measure concentrations of contamination.

Historically, for the lead smelter at Shymkent, soil contamination wasn't monitored. And while atmospheric emissions levels are indeed recorded, this happens non-continually, during office hours only. Clearly, with large emissions observed during the weekends as well as during the frequent upsets which occur during the week, this doesn't paint a true picture to the regulators. Pictured (overleaf) is the lead smelter during a typical weekend upset.

However, when violations are identified, the penalties are generally just not severe enough to encourage companies to invest in upgrading their facilities.

cleaning up Shymkent

After extensive risk assessment and modelling, the overall area considered for remediation in Shymkent was set as the area within a 400 mg/kg contour for lead in surface soil (50 km^2). This is consistent with cleanup goals at other sites worldwide and previous experience. Within this contamination zone, there are multiple land uses, including agricultural, industrial/commercial areas, residential districts, schools, parks, and playgrounds. No action is proposed for soil concentrations below this level.

ITFCEH's proposals for remediation include:

- removing soil from contact (removal and disposal in a safe location);
- removing exposure pathway (e.g. creation of clean play areas through covering with cleanable surfaces);
- reducing concentrations (soil mixing); and
- reducing bioavailability or uptake in the human body through using chemical treatments to convert the metals in the soil to non-bioavailable forms.

At the time of writing, we're actively seeking partners to help participate in this cleanup effort.

the legal small print

International companies working overseas should pay special attention to following the legislation of the country of origin, and the country of operation. Under company legislation of the host country, it's commonly written that a company must pay attention with regard to the impact of the company's operations on the community and the environment, and this is certainly true in the UK, where it's written into company law. If a company is aware that a contractor is intentionally breaking the legislation, they're often themselves creating an offence in their home jurisdiction in supporting this.

Any company having its base in an OECD member country is subject to the OECD Guidelines for Multinational Enterprises. Most governments expect all companies to follow the OECD Guidelines (in other words, these guidelines are quasi-legal). These guidelines state that enterprises should *"assess, and address in decision-making, the foreseeable environmental, health, and safety-related impacts associated with the processes, goods and services of the enterprise over their full lifecycle. Where these proposed activities may have significant environmental, health, or safety impacts, and where they are subject to a decision of a competent authority, prepare an appropriate environmental impact assessment."*

The legal implications are that companies clearly owe a duty to their shareholders, as well as the community, to perform full due diligence, including environmental impact assessment, over the product lifecycle. What might today be seen by many as a local problem could well be an economic disaster for the company in the future. Insurers might also have something to say on this. For example, asbestos claims today are the result of exposure 50–60 years ago.

what can we do?

ITFCEH has investigated many regions of the FSU, and is aware of many other severe industrially-contaminated regions, including contamination from nuclear waste, chromium, aluminium, and pesticides. Many of these sites are hidden, or not discussed openly.

The International Task Force for Children's Environmental Health (ITFCEH)

ITFCEH was created in 2011, bringing together some of the world's leading experts in the fields of heavy metals processing, environmental remediation, industrial hygiene, environmental legislation in the FSU, and chemical engineering. ITFCEH is actively seeking partners to help participate in the cleanup effort, whether in the field of charitable assistance such as planning the construction of clean children's playgrounds in Shymkent, or in the project to clean up the environmental problem itself. Offers of assistance, or enquiries, are welcome to **info@itfceh.org**

Weekday, office-hours monitoring of air emissions do not capture data for a typical weekend upset such as this one

City	Mean (µg/dl)+	Maximum (µg/dl)+	% Children poisoned* (>10 µg/dl) (%)
Kyzylorda	6	25	7
Pavlodar	5.4	30.3	9
Ust Kamen	6.6	29.4	15
Almaty	6.1	23.6	16
Tekeli	8.7	38.4	16
Taldy Korgan	8.9	32	20
Shymkent	20.7	103	66

+ µg lead per dl blood

** % Children under 7 years old poisoned as defined by WHO*

Table 2: Lead in blood in different cities of Kazakhstan

Whilst each country must implement its own Ecological Codes, ITFCEH believes that international companies involving themselves in a country should base their operations upon well-established international standards as a minimum. In particular, they should perform full due diligence, including taking account of environmental assessments of the impact of their involvement.

The international community should pay more attention to the regions where millions of children are affected by the environmental legacy of the USSR. The problems of the missing assessments exampled by the lead contamination in Shymkent, should be a 'must do' for environmental and public health organisations and institutions, as well as public companies. One of the reasons why not only local, but now even Western companies, can get away with poisoning of children in the FSU is that international structures do not pay enough attention to this problem.

ITFCEH is leading the effort to help remediate the problems of Shymkent, which will involve bringing in finance and new industries to help start the cleanup project. We are focussed on helping the President of Kazakhstan solve this problem, and extending our efforts across the region. **tce**

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