

Where 2B & Y

CHEMRAWN in Action—This Time with E-waste in Focus

by Leiv K. Sydnes

For years, electronic waste (e-waste) has been the waste stream growing the fastest globally. Considering the valuable metals this sort of waste contains, it would be natural to think that a bustling modern industry took care of its recycling in a sustainable way, but that is far from the case. In fact, no other waste is so much out of control as e-waste; globally, more than 50% of this waste just disappears and much of it pops up in several African countries, particularly in Nigeria. Here the waste is handled in various ways, but a common feature is that a lot of the handling is primitive and takes place under dubious and substandard working conditions. The result is that the e-waste recycling in these countries has had and continues to have a significant environmental impact. In this way, much fertile land has become useless, and tremendous clean-up operations must be carried out before the land again can be used for pasture and other agricultural purposes.

This inconsolable situation has been caused by many contributing factors, which collectively have generated entangled challenges that have been unsatisfactorily handled. The problems are basically caused by complex chemical processes that many chemists are not familiar with, but they are complicated by the lack of implementation of international conventions regulating transboundary movements of hazardous waste, for instance the Basel Convention from 1989 [1]. Additionally, many other environmental challenges of global proportions that e-waste issues have not reached proper attention. The resulting situation is very well described in many documents [see for instance 2-5], and what should to be done to solve the problem has been outlined in abundance [see text box]. Time for action is therefore overdue.

IUPAC on the move

Complex problems of the sort e-waste represents are challenges IUPAC has worked with since the middle of the 1970s, primarily through the CHEMRAWN committee (Chemical Research Applied to World Needs [6]). The committee works with major, multidisciplinary societal problems where chemical aspects are instrumental to understand and study to find a solution. The tool used to address the problems is to organize so-called CHEMRAWN conferences where relevant chemical aspects are presented and discussed, taking into consideration other challenges that have to be resolved to find an integrated way toward a solution [6].

Both lecturers and participants at these conferences have quite a varied background, just like the citizens that suffer from problem(s) under consideration.

The CHEMRAWN committee and an international team of specialists have worked for quite some time to prepare a conference on e-waste. Early on it was suggested that the meeting ought to be held in one of the African countries suffering the most from dubious and illegal dumping of such waste, and after some discussion, Nigeria was proposed. When the Chemical Society of Nigeria (CSN) was approached, the request to host *CHEMRAWN XXII E-waste in Africa* was very well received. Since then, the CHEMRAWN XXII task group and CSN have worked hard together to develop the conference program, make necessary venue preparations, and secure financial support. The work has been challenging for various reasons, the most important one being the corona pandemic, which spread a fair amount of pessimism and led to several postponements. However, toward the end of last year, the miserable future prospects resulted in an important decision: Instead of running a traditional conference, a hybrid meeting would be held at the end of 2021, November 9-11, in connection with the 44th Annual International Conference of the Chemical Society of Nigeria (<https://iupac.org/event/chemrawn-xxii-e-waste-in-africa/>). The physical part will be held in Lagos, Nigeria, while the virtual will be by either Zoom, Teams, or Skype. This removed a lot of the uncertainty related to travel and COVID-related restrictions, lowered the number of participants present in Lagos so that a more economic venue could be used, and made it possible to reduce travel costs significantly by opting for virtual delivery of the invited lectures. This will be the first CHEMRAWN conference in the hybrid format, and if successful, it will open future scientific meetings in countries where IUPAC has been totally absent for more than 100 years.

CHEMRAWN XXII

If the e-waste problem is going to be solved, coordinated efforts involving scientists from several disciplines, politicians at regional and national levels, and representatives from international organizations have to be put in place and executed in close collaboration with relevant industries, national non-governmental organizations, and media. The conference will include representatives from all these groups, and they will be involved in the lecture program, group discussions, poster sessions, roundtable discussions, and a field trip (physical for the participants in Lagos and by drone for the virtual participants).



E-waste handling under sub-standard conditions near Lagos, Nigeria (photo: Leiv K. Sydnnes).

Since the reasons for and the solution of the e-waste problems are chemical in nature, the conference will basically be a chemical congress, but the chemical actions and initiatives will be put in a wider perspective to understand the importance of implementing a number of significant measures at the same time.

Several lectures will focus on the dynamics of the e-waste market and present the environmental and health damages caused by the lack of control of the handling of the waste. Special attention will be paid to the situation in Africa where the impact of e-waste

going astray in other parts of the world, particularly in Europe and the Middle East, is appalling.

Other lectures will present new technologies that are continually introduced to obtain purer and more useful products from the e-waste under cleaner, safer, and healthier conditions. Some technologies are applied to remove toxic organic chemicals safely, others to separate precious metals more efficiently, and finally, some to utilize residual waste to make new products. This will generate opportunities to establish new industries, which indeed will be needed to find employment for

The global impact of e-waste: Addressing the challenge (extract from reference 5)

“Within the informal economy of such countries [China, India, Ghana and Nigeria], it is recycled for its many valuable materials by recyclers using rudimentary techniques. Such globalization of e-waste has adverse environmental and health implications. Furthermore, developing countries are shouldering a disproportionate burden of a global problem without having the technology to deal with it. In addition, developing countries themselves are increasingly generating significant quantities of e-waste.

It is clear that the future of e-waste management depends not only on the effectiveness of local government authorities working with the operators of recycling services but also on community participation, together with national, regional and global initiatives.

The solution to the e-waste problem is not simply the banning of transboundary movements of e-waste, as domestic generation accounts for a significant proportion of e-waste in all countries. Fundamental to a sustainable solution will be tackling the fact that current practices and the illegal trade provide economic stimulus. It is important to recognize local and regional contexts and the social implications of the issue; implementing a high-tech, capital-intensive recycling process will not be appropriate in every country or region. Effective regulation must be combined with incentives for recyclers in the informal sector not to engage in destructive processes. Cheap, safe,

and simple processing methods for introduction into the informal sector are currently lacking; hence, it is necessary to create a financial incentive for recyclers operating in the informal sector to deliver recovered parts to central collection sites rather than process them themselves. Multidisciplinary solutions are vital in addition to technical solutions, as is addressing the underlying social inequities inherent in the e-waste business.

Recycling operations in the informal sector of the economy enable employment for hundreds of thousands of people in poverty. A possible entry point to address their negative impacts is to address occupational risks, targeting poverty as the root cause of hazardous work and, in the process, developing decent working conditions. More generally, solutions to the global e-waste problem involve awareness raising among both consumers and e-waste recyclers in the informal economy, integration of the informal sector with the formal, creating green jobs, enforcing legislation and labour standards, and eliminating practices, which are harmful to human health and the environment. It is also imperative to target electrical and electronics manufacturers by introducing Extended Producer Responsibility (EPR) legislation and encouraging initial designs to be green, long lived, upgradeable and built for recycling.”



Typical handling of waste from computers and televisions in Ghana (from <https://www.wired.com/story/international-electronic-waste-photographs>).

all the people that will be out of work when e-waste handling becomes much better controlled. In order to stimulate such a shift, a course in entrepreneurship will be held, mainly for young chemists and experienced students in chemistry and environmental sciences.

In general, the knowledge about chemical problems related to the e-waste recycling is rather low even among well-educated chemists. This is primarily due to the fact that educational programmes in chemistry at university level include little or nothing about the topic. However, in some countries, university chemistry courses cover e-waste handling to some extent, and some of them will be presented and discussed in break-out groups.

If the problems associated with e-waste are going to be reduced and eventually solved, a strong involvement by a well-informed public is required. An active education of the public is therefore necessary, and a strong outreach program, dealing with the impact of e-waste on nature, people, and climate, has therefore to be developed and implemented. A lot of excellent material is already available on the web, and inspired by this, ideas for future IUPAC activities will be discussed planned.

Before closing, a special feature of the CHEMRAWN conferences should be mentioned, *viz.* a working group

named the Future Action Committee. This group connects before the conference to plan its activity, it meets every day during the conference to discuss what has been presented, and after the conference it develops ideas and projects for subsequent implementation. In this way a range of projects have been generated based on CHEMRAWN conferences over the years, and among their outcomes are scientific publications, books, technical reports, educational material, the *CHEMRAWN VII Prize for Green Chemistry*, and plans for establishing a center for herbal medicine in Dhaka, Bangladesh.

Through the years, I have participated in quite a few CHEMRAWN conferences, and it has always been interesting to experience how chemical problems are understood by audiences that reflect the civil society much better than groups of chemists gathered to discuss chemistry. I therefore recommend CHEMRAWN XXII, which I am sure will give up-to-date knowledge about a tremendous global problem that can only be solved by a strong involvement from the chemical community.

References

1. The name of the convention is the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, which came into effect 5 May 1992. <http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx>
2. United Nations Environment Management Group (2017), *United Nations System-wide Response to Tackling E-waste*, <https://unemg.org/images/emgdocs/ewaste/E-Waste-EMG-FINAL.pdf>
3. A New Circular Vision for Electronics, http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf
4. <https://www.smithsonianmag.com/science-nature/burning-truth-behind-e-waste-dump-africa-180957597/>
5. From the abstract of the International Labor Office (ILO) report “*The global impact of e-waste; Addressing the challenge*”, published by Karin Lundgren (2012) (https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_196105.pdf).
6. On an average, there has been a CHEMRAWN conference about central issues every second year since the committee was established in 1974. A thorough presentation of the committee’s work and the CHEMRAWN conferences was recently published in the IUPAC chemical magazine *Chemistry International* April 2021, 43(2), pp. 20-26; <https://doi.org/10.1515/ci-2021-0205>

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