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Metallurgy's Impact on Public Health

Adrian IOANA[1]

Abstract

This article presents and analyzes the correlations between public health, family and metallurgy. The focus in this triple analysis is particularlly set on health. To this end, the starting point of this article is the correlation between metallurgy, the economic impact and health and the impact theirof. The article presents the main adverse effects of metallurgy on public health and family. Thus, the main illnesses (professional and others) are directly related to their causes generated by metallurgy. Siderosis (caused by iron dust), silicosis (caused by free crystalline silicon dioxide), laryngeal neoplasm (caused by asbestos), are only a few examples in this regard. Correlations between metallurgy, health and family are analyzed in multidisciplinary terms (medical, social, technical). In the same context correlations between pollution, technology level, unemployment and family are analyzed. The paper aims to create awareness in the society, in the broad sense, (and particularly specialists) about latent risks and dangers in the triplet Health - Family - Metallurgy. The main conclusions of the article are: unfortunately, metallurgy negatively affects public health; this highly complex triad, Metallurgy - Public Health – Family, should be considered a mandatory study for an interdisciplinary team of professionals that includes the following areas: medicine, metallurgical engineering, socio-economic sciences.

Keywords: public health; family; metallurgy; pollution; sustainable development; Electric Arc Furnace (EAF).

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Introduction

It is known that the steel industry is heavily polluted (Ioana, 2007, Nicolae, Nicolae, Tudor, Licurici, Mândru, Ioana, 2004). We all know that pollution affects health (Cojocaru, 2012). However, we can not live without metallurgy (Ioana, Semenescu, Preda, 2012). The essential question to ask is: what is paramount, the economic effect of metallurgy, or the adversely affected public health and family because of metallurgy? It is not easy to answer this question (Bushe & Kassam, 2005, Carson, Tesluk, Marrone, 2007, Hart, Conklin, Allen, 2008). I will try to make a case for either of the alternatives in this article based on rational, scientific and social arguments. Figure 1 shows schematically the starting point of this article (Ioana, Semenescu, Marcu, 2011; Ioana, 2009). Metallurgy, as industrial and social specific domain, produces social effects and health effects too. Among the most important social effects of metallurgy, we can consider that: provides a large number of jobs and thus a high degree of social security; provides multiple correlations in horizontal industry (civil and industrial building, automotive, chemicals, etc.). On the other hand, metallurgy, due to high levels of polluting (emissions, imissions), may adversely affect the health of both the employees in the field, and the residents in the vicinity of metallurgical plants.

Paraphrasing a well known adage “If it is not love, nothing is” (saying that unfortunately many attribute it wrong for Marin Preda - the reason lait novel “The most beloved of Earth” - but it is a quote from the Bible, the words of St. Paul) , I say with all the strength and conviction “If there’s metallurgy, nothing is!” (Ioana & Bălescu, 2011; Ioana, Nicolae, 2002). Arguments in support of this dictum are multiple. I present below some of them. Metallurgy is inevitably the basis of many industries, such as: construction (civil and industrial), transportation, aerospace, energy, etc. (Ioana, Mirea, & Bălescu, 2009; 2010). Without exaggeration, I can say that it is hard to find an area (domestic or industrial) which does not need metallurgy. *Figures 1-4* present national metallurgy relevant images.

Steel platform on the bank of the Borcea river produced 200,000 tons of steel per year before the 1990’s. Initially about 6,000 people were emplyed there, their number being dramatically reduced recently. Currently, only about 500 people still working on the platform. Of these, 300 working at the steel plant and 70 at the rolling mill.

Figure 1. Blat Furnace no.1 Hunedoara

Figure 2. Oțelu Roşu steel mill

Figure 3. Steel worker in the front of the furnace

Figure 4. SIDERCA Călăraşi former steel mill

Metallurgy's Harmful effects on public health and family

The Metallurgy sector is a heavy polluter (Iovu & Iordan, 2012). Particularlly because it is such a high energy-consuming industry, metallurgy's pollution is particularly high.

Figures 5 and 6 present relevant images of pollution in metallurgy.

Figure 5. Pollution of Galati Steel Works

Figure 6. Pollution of blast furnaces

The main pollutant emissions (emissions and imissions) in metallurgy (Electric Arc Furnace – EAF) are presented in *Tables 1 and 2* (Ioana et all, 2002).

Table 1. Emission type and percentaje for Electric Arc Furnace (EAF)

No	Emission type	Technological step of the elaboration process	Emission weight (%)
1.	Primary	Melting – Refining	91
2.	Secondary	Loading	3.75
		Evacuation	4.5
		Through lack of tightness (door, arched tank, the space around the electrodes)	0.75

Table 2. Burnt gas composition of EAF

No	Collecting time [min.]	Burnt gas composition			
		O_2 [%]	CO_2 [%]	CO [ppm]	NO_x [ppm]
1.	30	20.7	0.4	1,305	45
2.	50	14.0	6.2	8,800	662
3.	80	19.81	1.0	8	74
4.	15	19.1	0.5	5,816	39
5.	30	16.5	3.9	13,250	115
6.	50	18.7	2.1	6,906	176
7.	75	18.8	2.0	15,000	667
8.	80	19.7	1.2	42	402
9.	90	20.2	1.2	21	1,045
10.	4	19.2	1.7	202	835
11.	19	18.9	1.9	1,798	147
12.	39	19.9	3.6	13,134	345
13.	54	18.1	2.5	716	400
14.	64	18.1	2.7	18	196
15.	15	19.4	1.4	158	750
15.	40	13.2	6.8	11,000	293
17.	55	16.7	3.8	609	359
18.	75	19.4	1.4	10	120

The main damages to health caused by metallurgical pollution (and their causes) are (Pop, 2010; Precupetu, Vasile & Vlase, 2013; Furnee, Groot & Pfann, 2011; Felea et al, 2013; Ioana, 2007; Ioana and Nicolae, 2002):

Malignancies: (1) Nasal cavity Cancer (nickel compounds) (Shangina et al, 2006; Kogevinas, Sala & Boffetta, 1998) ; (2) Laryngeal cancer (asbestos) (Pop, 2010); (3) Bronchial and pulmonary cancer (asbestos, arsenic and its compounds, nickel compounds, produced by the decay of radon, free crystalline silica, bisclor-metileter, beryllium, cadmium) (Felea et al, 2013; Ioana, 2007); (4) Neoplasm of bone and articular cartilage of limbs and other locations (ionizing radiation) (Ioana & Nicolae, 2002); (5) Skin cancers: squamous cell carcinoma (arsenic, produced by gasification of coal, mineral oil) (Kogevinas, Sala & Boffetta, 1998); (6) Mesothelioma: pleural mesothelioma, peritoneal mesothelioma (asbestos) (Pop, 2010); (7) Bladder cancer (aromatic amines); (8) Leukemia: lymphoid leukemia, myeloid leukemia, other leukemias with specific cells (ionizing radiation, benzene) (Kogevinas, Sala & Boffetta, 1998).

- Occupational diseases caused by exposure to physical agents: (1) Heat shock, heat collapse, caloric cramps (warm microclimate) (Ioana & Nicolae, 2002); (2) Hypothermia, frostbite (cold microclimate) (Shangina et al, 2006); (3) Vibration disease: articular syndrome musculoskeletal, digestive syndrome, Raynaud syndrome, nervous syndrome (vibration) (Precupetu, Vasile & Vlase, 2013); (4) Cardiovascular and neuro-endocrine syndromes (electric and magnetic fields, non-ionizing electromagnetic radiation from microwave and RF banda) (Furnee, Groot & Pfann, 2011).

- Diseases of the respiratory system: (1) Siderosis (iron powder) (Felea et al, 2013); (2) Silicosis, silicotuberculosis (free crystalline silica) (Ioana, 2007); (3) Coal pneumoconiosis (coal dust) (Ioana & Nicolae, 2002); (4) Asbestosis (asbestos) (McGill, McMahan & Gidding, 2008); (5) Pulmonary aluminoza (aluminum) (Kogevinas, Sala & Boffetta, 1998); (6) Pulmonary fibrosis (irritating gases and vapors) (Pop, 2010); (7) Berilioza (beryllium) (Ioana, 2007); (8) Stanoza (dusts and fumes of tin) (Ioana & Nicolae, 2002); (9) Pneumoconiosis due to other inorganic dust (particulate inorganic mixed) (Shangina et al, 2006); (10) Benign lung: benign pleural effusion, atelectasis, round pleural plaques (asbestos) (Kogevinas, Sala & Boffetta, 1998); (11) Interstitial pneumonia (heavy metals: Pb, Hg, Cd, Cr, Sn); (12) Acute and chronic bronchitis (chemicals) (Furnee, Groot & Pfann, 2011); (13) Nasal ulceration and perforation of the nasal septum (chromium, arsenic and their compounds) (Pop, 2010).

Discussion

Analysis of weights EAF emission types highlights the following (*Figure 7*): (1) The main and most dangerous emission is from melting – refining, as primary emission type (91% weight); (2) At the opposite (least dangerous) are emissions through lack of tightness (door, arched tank, the space around the electrodes), as secondary emission type (0.75 % weight); (3) Should pay attention to the emission of loading (3.75% weight) and evacuation (4.5% weight) technological phase.

Particulate matter in ambient air pollution is an important polluting factor. PM2.5 refer to 2.5 μm particulate matter which passes through a size-selective inlet. This aspect is provided by CSN EN 14907 European Standard. This European Standard describes a standard method for determining the PM2,5 mass concentration of suspended particulate matter in ambient air by sampling the particulate matter on filters and weighing them by means of a balance. Measurements are made over a sampling period of about 24 h, and in line with the Directive, are expressed as μg/m3, where the volume of air is the volume at ambient conditions near the inlet at the time of sampling. PM2.5 is defined as more than 50% of the particles are collected sampler having a diameter of 2.5 μm. The maximum allowable value is 50 mg/m^3. The range of application of the standard is from 1 μg/m3 (i.e. the limit of detection of the standard measurement method expressed as its uncertainty) up to 120 μg/m3 (i.e. the maximum concentration level observed during the field study undertaken by CEN/TC 264/WG 15 to validate the standard). PM2.5 is linked to cardiovascular disease. For each increase of 10 mg/m³ of PM2.5 is estimated 8-18% mortality risk from cardiovascular disease. Long-term exposure increases the risk of atherosclerosis and inflammatory diseases of the heart.

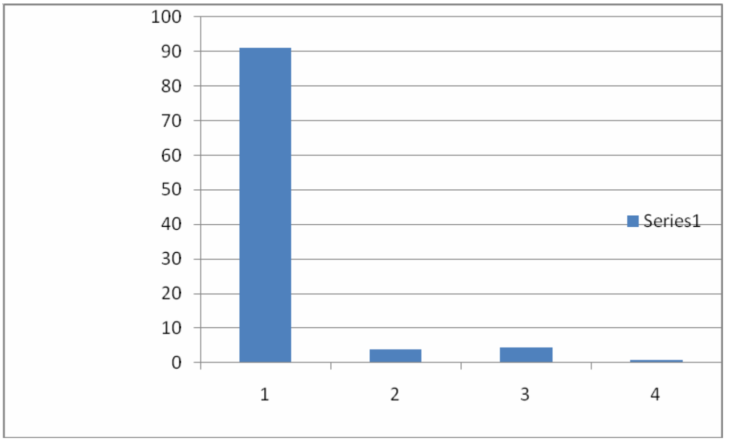

Figure 7. EAF emissions variations on technological phases ș%ț

1 – Melting – Refining; 2 – Loading; 3 – Evacuation; 4 – Through lack of tightness

The most harmful (dangerous) component of the exhaust from EAF melting is carbon monoxide (*figure 8*).

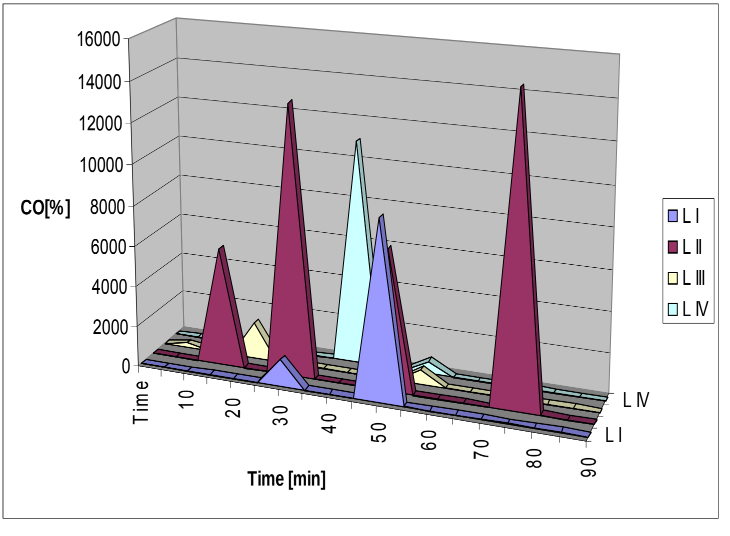

Figure 8. The CO concentration in the evacuated gas during the melting in the EAF, L I, L II, L III, L IV – EAF's melting

As data shown in *Table 2*, the variation range of the carbon monoxide that expresses the burnt gas' low energetic content, substantially increases from 13,134 ppm for the reference load (L III), up to 15,000 ppm for load II (30% cast iron, 10% pallets, 60% scrap iron) and for the loads I and IV (30% cast iron, 70% scrap iron), it decreased to 8,800 ppm and, respectively, 11,000 ppm. It should be noticed that both the increases and the decreases of the range are by changing the superior limits, the inferior limits (the minimum values) staying more or less the same in the 8 – 42 ppm range. Carbon monoxide poisoning occurs when carbon monoxide mix blood and binds to hemoglobin to form carboxyhemoglobin (COHb). The main factors that cause body damage after carbon monoxide poisoning include: (1) the ability to vent the place where there is carbon monoxide; (2) the amount of carbon monoxide inhaled; (3) the time when the person is exposed to carbon monoxide.

All these problems (and many others that I have not mentioned) seriously damages public health in general (Popescu, 2012), especially the health of the metallurgy workers' families in metallurgy. Correlations which must be highlighted by both medical and social experts and specialists in metallurgy (Stanescu & Cicei, 2012; Ioana, 2013). To reduce the causes that have been inflicted on health, it is necessary (not enough, unfortunately) to reduce the pollution (and) in metallurgy. Reduction (decrease) of pollution in general (and especially in metallurgy) has beneficial effects for Sustainable Development (Pop, 2010; Popescu, 2012). Another reason for the need to reduce pollution in general (and especially in metallurgy) to improve the health of the population are consists of multiple and serious illnesses detected (silicosis, malignant mesothelioma etc). Reducing pollution in metallurgy is directly dependent on the increase of sector-specific technology. A high-technology (automation, robotics) unfortunatelly entails reducing the need for human labor, with possible negative consequences on unemployment (Runcan, Goian, Tiru, 2012, Barret & Cooperrider, 1990). High unemployment directly and fully affects family security in a negative way. Between pollution, technological level, unemployment, health and family are obvious correlations. Thus, I mention some of these correlations (Felea et al, 2013; Furnee et al, 2011, Precupetu, Vasile and Vlase, 2013; Ioana, 2013, 2007): (1) Protecting public health and safety of the family are favored by reducing pollution in general (and especially in metallurgy); (2) Pollution reduction (decrease) requires a high technological level; (4) Increasing the level of technology generally attract higher unemployment. Paradoxically, to protect public health, reducing pollution in metallurgy (and not only), by increasing technology brings possible rises in unemployment which in turn impacts the family.

Conclusions

It is obvious that pollution (especially pronounced pollution, as in metallurgy) causes various diseases. Thus, examples are: emphasized noise causes deafness; thermal and light radiation cause blindness; pollutants (CO, NO_x, etc.) poisoning causes cancer. In metallurgical plants, unfortunately, there are conditions and situations that may adversely affect public health and family security by default. Thus, the data (Table 1, 2) and analyzes argues the following conclusions: (1) The highest content of carbon monoxide emissions are for melting technological phase of EAF and varies between 8 and 15,000 ppm; (2) The content of NO_x gases to steelmaking EAF range from 45 to 1,045 ppm and is also harmful to health. Unfortunately, metallurgy negatively affects public health. Correlations between public health, family and metallurgy are obvious and important. The rationale of these correlations lies in data and analyzes presented: (1) High levels of noxious pollutants in metallurgy adversely affect public health; (2) Adversely affect public health reduce the security of the family. Their importance lies in the possibly (and, unfortunately, many times actual) negative consequences of these correlations, both for public health and the family. What should we do? First, this highly complex triad, Metallurgy - Public Health – Family, should be considered a mandatory study for an interdisciplinary team of professionals that includes the following areas: medicine, metallurgical engineering, socio-economic sciences. Analysis must be constant and professional. The ultimate goal is to optimize this triad (Metallurgy - Public Health – Family), by giving priority to public health and family. The diminishing of the negative effects on the family, caused by rising unemployment (according to BIM methodology, for 2013, the unemployment rate in Romania is 7.5%, generated, in turn, by raising the technological level), may be facilitated by additional ecological measures (which are often mandatory).

References

Barrett, F. J., Cooperrider, D. L. (1990). Generative metaphor intervention: A new approach for working with systems divided by conflict and caught in defensive perception. *Journal of Applied Behavioral Science*, vol. 26(2), 219-239.

Bushe, G. R., Kassam, A. F. (2005). When is Appreciative Inquiry transformational?: A meta-case analysis. *Journal of Applied Behavioral Science*, 41(2), 161-181.

Carson, J. B., Tesluk, P. E., Marrone, J. A. (2007). Shared leadership in teams: An investigation of antecedent conditions and performances. *Academy of Management Journal*, 50(5), 1217-1234.

Cojocaru, D. (2012). Appreciative Inquiry and Organisational Change. Applications in Medical Services. *Revista de Cercetare si Interventie Sociala*, 38, 122-131.

Felea, M.G., Mitu, F., Covrig, M., Chiriac, S., Trifan, A., Pandele, G.I., Negru, R. (2013). A Public Health Challenge – Influence on Alcohol Pattern in Liver Cirrhotic

Patients with or without Diabetes Mellitus, *Revista de Cercetare si Interventie Sociala*, 41, 96-105.

Furnee, C.A., Groot, W., Pfann, G.A. (2011). Health and income: a meta-analysis to explore cross-country, gender and age differences. *European Journal of Public Health*, 21(6), 775-780.

Hart, R, K., Conklin, T. A., Allen, S. J. (2008). Individual leader development: An Appreciative Inquiry approach. *Advances in Developing Human Resources*, 10(5), 632-650.

Ioana, A., Semenescu, A., Preda, C.F. (2012), *Management Strategic. Teorie și Aplicații*. București: Matrix Rom.

Ioana, A., Semenescu, A., Marcu, D. (2011). *Bazele Mananagementului. Teorie și Aplicații*. București: Editura Matrix Rom.

Ioana, A. (2007). *Managementul producției în industria materialelor metalice. Teorie și aplicații*, București: Editura Printech.

Ioana, A., (2009). *Managementul activității financiar-contabile și analize economice. Teorie și Aplicații*, București: Editura Politehnica Press.

Ioana, A. (2013). Elements of the EAF's Environmental Management, *Tehnomus Journal, New Technologies and Products in Machine Manufacturing Technologies*, 1, 334-337.

Ioana, A., & Nicolae, A., (2002). *Conducerea Optimală a Cuptoarelor cu Arc Electric*, București: Editura Fair Partners.

Ioana, A., Mirea, V. & Bălescu, C. (2010). Economic Processes Study through Fuzzy Logic. *Journal of Economic Computation and Economic Cybernetics Studies and Research*, 2, 129-138.

Ioana, A., Mirea, V. & Bălescu, C. (2009). Analysis of Service Quality Management in the Materials Industry Using the BCG Matrix Method. *Amfiteatru Economic Review*, XI(26), 270-278.

Iovu, M.B., Runcan, P. (2012). Evidence-Based Practice: Knowledge, Attitudes, and Beliefs of Social Workers in Romania. *Revista de Cercetare si Interventie Sociala*, 38, 54-70.

Kogevinas, M., Sala, M., Boffetta, P. (1998). Cancer risk in the rubber industry: a review of the recent epidemiological evidence. *Occupation Environment Medical*, 55, 1-12.

McGill, HC., McMahan, CA., Gidding, SS. (2008). Preventing heart disease in the 21st century: implications of the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study, *Contemporary Reviews in Cardiovascular Medicine, Circulation*, 117(9), 1216–1227.

Nicolae, A., Nicolae, Maria, Tudor, P., Licurici, M., Mândru, C., & Ioana, A. (2004). *Dezvoltare durabilă în siderurgie prin valorificarea materialelor secundare*, București: Printech.

Pop, C. (2010). Starea de sănătate a populației din România în context European. O abordare din perspectiva calității vieții. *Calitatea Vieții*, 21(3-4), 274-305.

Precupetu, I., Vasile, M., & Vlase, I. (2013), Individual and Contextual Factors in Self-Rated Health Inequalities: A Comparison between Romania, 10NMS and EU15, *Revista de Cercetare si Interventie Sociala*, 41, 28-39.

Popescu, A.I. (2012). Lifelong Learning in the Knowledge Economy: Considerations on the Lifelong Learning System in Romania from a European Perspective. *Revista de Cercetare si Interventie Sociala*, 37, 49-76.

Runcan, P.L., Goian, C., Tiru, L. (2012). The Socio-Communicational Style and the Need for Supervision of Professionals from the Social Services. *Revista de Cercetare si Interventie Sociala*, 37, 180-195.

Shangina, O., Brennan, P., Szeszenia-Dabrowska, N., Mates, D., Fabia, E., Fletcher, T., t'Mannetje, A., Boffetta, P., Zaridze, D. (2006). Occupational Exposure and Laryngeal and Hypopharyngeal Cancer Risk in Central and Eastern Europe. *American Journal of Epidemiology*, 164(4), 367-375.

Stanescu, D.F., Cicei, C.C. (2012). Leadership Styles and Emotional Intelligence of Romanian Public Managers. *Revista de Cercetare si Interventie Sociala*, 38, 107-121.

*** CSN EN 14907, Ambient air quality - Standard gravimetric measurement method for the determination of the PM2,5 mass fraction of suspended particulate matter