Dioxins in Vietnam: Characterization, Monitoring, Remediation and Effects

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This session is comprised of eight oral presentations and eight posters that focus on dioxin (TCDD) and closely related chemicals in Vietnam. The session is essentially divided into two distinct areas. The presentations in the first half of the session are primarily directed toward characterization of the levels of dioxins and related halogenated organics in environmental, biological and food samples as well as a presentation on microbial remediation of dioxin-contaminated soils. The presentations in the latter half of the session are focused on dioxin as they relate to exposure and effects in Vietnam veterans.

The extent and levels of dioxin contamination throughout Vietnam in both environmental, biological and food samples is not well established and as such, limited data is available to allow for appropriate epidemiological assessments. Tuan Anh Mai and coworkers (Vietnam, Switzerland) in their presentation entitled "Dioxin contamination in the soil – South of Vietnam", describe the results of studies on measurement of the extent of dioxin contamination in Vietnam. Their studies were focused on instrumental analysis of soil samples from three documented areas of contamination: Ma Da Forest, Cam Lo District and Da Nang Airport. While the results of their analysis revealed low or nondetectable levels of TCDD/F in most samples, hepta- to octa-CDDs were present in most samples. Calculated TEQs for the sites indicated that 15/20 had levels exceeding the TEQ limit based on Canadian Guidelines. Arnold Schecter and coworkers (USA, Vietnam, Germany) in their presentation entitled "Halogenated organics in Vietnamese and in Vietnam food: Dioxins, dibenzofurans, PCBs, polybrominated diphenyl ethers and selected pesticides" describe analysis of blood and food samples from a more diverse set of "hot spot" samples from North, South and Central Vietnam. Relatively high levels of TCDD and TCDD TEQs were found in some but not all food samples from areas in which Agent Orange was sprayed. In general, while "hot spots" of relatively high levels of dioxin are found, quite low levels of dioxin were found in most of Vietnam. However, other persistent organic pollutants (DDT, HCH, HCB, PBDEs and PCBs) were found to be present in many samples. It is very likely that 'hot spots" (local reservoirs) may act as an important exposure pathway for humans living in the area of relevance. Paepke and colleagues (Germany, Vietnam, USA) analyzed blood samples from 3 different "hot spots" in the southern part of Vietnam. In one case (Bien Hoa City) the exposure seemed to be correlated with locally grown food which had been consumed by individuals showing elevated blood levels for TCDD (maximum value: 413 pg/g lipid). From the Bien Hoa area values for sediment and soil are available as well. Their most recent analysis of 24 blood samples originating from 2 other Vietnamese cities, showed elevated values for TCDD only or for other selected PCDD/F congeners. The source for the latter chemicals is currently unknown. While identification of contaminated areas is a key first step, remediation and clean-up of contaminated areas to minimize exposure and adverse effects is critical. Dang Thi Cam Ha and coworkers (Vietnam, Germany) in their presentation "Biodegradation of 2,3,7,8-TCDD by anaerobic and aerobic microcosms collected from bioremediation treatments for cleaning up dioxin contaminated soils" describe studies directed toward dioxin bioremediation. Initial studies of an anaerobic consortium of several bacteria and one

fungal strain was sufficient to degrade TCDD at a rate of 118 pg/ml TCDD after 133 under sulfate reduction, reducing the concentration of dioxin in the soil extract by 81%. The isolation and characterization of a TCDD-degrading microorganism, designated FDN30 which uses TCDD as its sole carbon and energy source is described. This organism could remove ~59% of TCDD TEQs from a soil extract after two weeks. These results suggest that bioremediation approaches may be feasible at contamination hot spots at former military bases.

Nathan J. Karch and coworkers (USA) in their presentation "Environmental fate of TCDD and Agent Orange and bioavailability to troops in Vietnam" reviews what is known about the environmental fate of TCDD and discusses how this affects the bioavailability of TCDD for former ground troops in Vietnam. Factors including Agent Orange dispersal and TCDD concentrations, forest canopy and leaf area index, photochemical degradation aspects, soil penetration and skin absorption. They conclude that the prospect of exposure to Agent Orange in ground troops in Vietnam seems unlikely in light of the environmental fate of TCDD and the herbicides in circumstances likely to have occurred in Vietnam. Appreciable exposure would require repeated long-term contact such as that experienced by Ranch Hand and Chemical Corps veterans who handled or otherwise had direct contact with the liquid herbicide. While no increases in Ranch Hand cancer mortality and morbidity were found in earlier studies, recent studies suggested increased rates in cancer in all SEER sites, Ranch Hand veterans and cancer in comparison veterans. Pavuk and coworkers (USA) in their presentation "Cancer in US Air Force veterans not involved with spraying herbicides during the Vietnam War" examined in more detail whether years served in Southeast Asia (SEA) had any effect on the risk of cancer among comparison veterans. They observed increased trends in prostate cancer risk with years served in the SEA region in comparison Air Force veterans not exposed to dioxin-contaminated herbicides. They suggest that time spent in SEA may be a surrogate for a major risk factor or combination of risk factors not previously recognized. In addition to US troops, Australian Defence Force (ADF) personnel also participated in the Vietnam Conflict, the majority in Phuoc Tuy Province, an area incurring heavy herbicide spraying. Given the increased cancer and heart disease risks of Vietnam veterans, Eileen Wilson and colleagues (Australia) describe the first cancer incidence study for all ADF Vietnam veterans in their presentation "Cancer incidence in Australian Vietnam veterans". The analysis reveals that the incidence rate for all cancers was 18% higher than the matched Australian male community, with significant elevations in colorectum, prostate, head and neck, oropharynx and larynx and lung. In addition, while the incidence rate for Hodgkin's disease was more than double the Australian rate and incidence of melanoma and chronic lymphocytic leukemia was also elevated, the rate of liver cancer, non-Hodgkin's lymphoma and multiple myeloma was statistically lower than community norms. The pattern of neoplasms among Australian Vietnam veterans was unexpected. The pattern of statistically elevated or lower cancer incidence rates varied between the service branches. Previous studies of post-service mortality of US Vietnam veterans have yielded mixed results, while the US Army Chemical Corps Study reported increased morality due to digestive disease and a non-significant increase in cancer deaths. The presentation by Norma Ketchum and Joel Michalek (USA) entitled "Mortality of Air Force veterans exposed to herbicides during

the Vietnam War" is an updated summary of all-cause and cause-specific post-service mortality in veterans of Operation Ranch Hand. They found a significant increase in the relative risk of death from diseases of the circulatory system in Ranch Hand enlisted ground crew, the subgroup with the highest dioxin levels.