New Protective clothing materials for working with handheld ultra-high pressure water jet guns

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Abstract

In many applications, hand-held water spray systems are replacing sandblasting as a cost effective and environmentally friendly alternative. In addition, waterjet technology offers new solutions for cleaning surfaces in difficult or confined spaces where sandblasting is virtually impossible. While operations in the manufacturing process are automated, water blasting requires the worker to operate a lance or spray gun by hand. Such hand-held high-pressure and ultra high-pressure water jet lances operate at pressures of up to 3,000bar. Typical injuries during operating with handheld guns include: shooting through shoes and feet with the water jet, injection of contaminated fluids in the lower leg and thigh area, at torso, hands and lower arms. Due to the international lack of suitable protective clothing systems, in particular for the use of water jet lances with round jet nozzle with pressures $>$ 500bar, the objectives of a project were 1)the development of protectors (knee and shin protectors, gaiters, aprons) based on metallic platelet structures, which should provide effective protection against punctual sources with pressures of at least 1,550 bar when using round jet nozzle and 2)the development of a technology for sewing on the platelet structures, in particular an automatic feeding of the plates on an automatic button sewing machine. The protectors should guarantee free movement and sufficiently high flexibility, and can be designed as knee and shin protectors, gaiters and aprons. The mass per unit area of the overall system, including waterproof protective covers, should not exceed 900g/m2. In order to estimate the number of platelets and the mass of the protectors, the required number of platelets and the masses for a 0.3 mm or 0.5 mm thick stainless steel were calculated for different platelet shapes and platelet sizes. A high-density knitted fabric made of textured polyester yarns was used as the substrate. For fixing the metal platelets to the substrate a modified automatic button sewing machines was used. The performance levels of the protective clothing materials against high-pressure water jets were tested according to DIN19430 standard, "Protective clothing – Clothing against high-pressure water jets – Requirements and test methods" by Hammelmann GmbH, Oelde. Developed protector structures offer protection against the various water jet applications: round jet nozzle up to 500 bar, rotary and fun nozzle up to 1000 bar.

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